US011579553B2

(12) **United States Patent**
Abe

(10) **Patent No.: US 11,579,553 B2**
(45) **Date of Patent: Feb. 14, 2023**

(54) **PHOTO-INTERRUPTOR UNIT, SHEET CONVEYANCE APPARATUS AND IMAGE FORMING APPARATUS**

(71) Applicant: **CANON KABUSHIKI KAISHA**, Tokyo (JP)

(72) Inventor: **Hideto Abe**, Toride (JP)

(73) Assignee: **CANON KABUSHIKI KAISHA**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 125 days.

(21) Appl. No.: **16/851,151**

(22) Filed: **Apr. 17, 2020**

(65) **Prior Publication Data**

US 2020/0356036 A1 Nov. 12, 2020

(30) **Foreign Application Priority Data**

May 10, 2019 (JP) JP2019-090180

(51) **Int. Cl.**
G03G 15/00 (2006.01)
G03G 21/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/5029*** (2013.01); ***G03G 21/1695*** (2013.01); *G03G 2215/00721* (2013.01); *G03G 2221/1606* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/5029; G03G 21/1695; G03G 2215/00721; G03G 2221/1606; G03G 2215/00616; G03G 2215/00628
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,338,435 A * 8/1994 Betts A61B 5/15003 204/406
6,399,943 B1 * 6/2002 Sano H01L 31/0203 250/239
6,677,580 B1 * 1/2004 Sano H01L 31/16 250/239
9,312,403 B2 * 4/2016 Miyata H01L 31/167
10,139,761 B2 11/2018 Abe et al.

(Continued)

FOREIGN PATENT DOCUMENTS

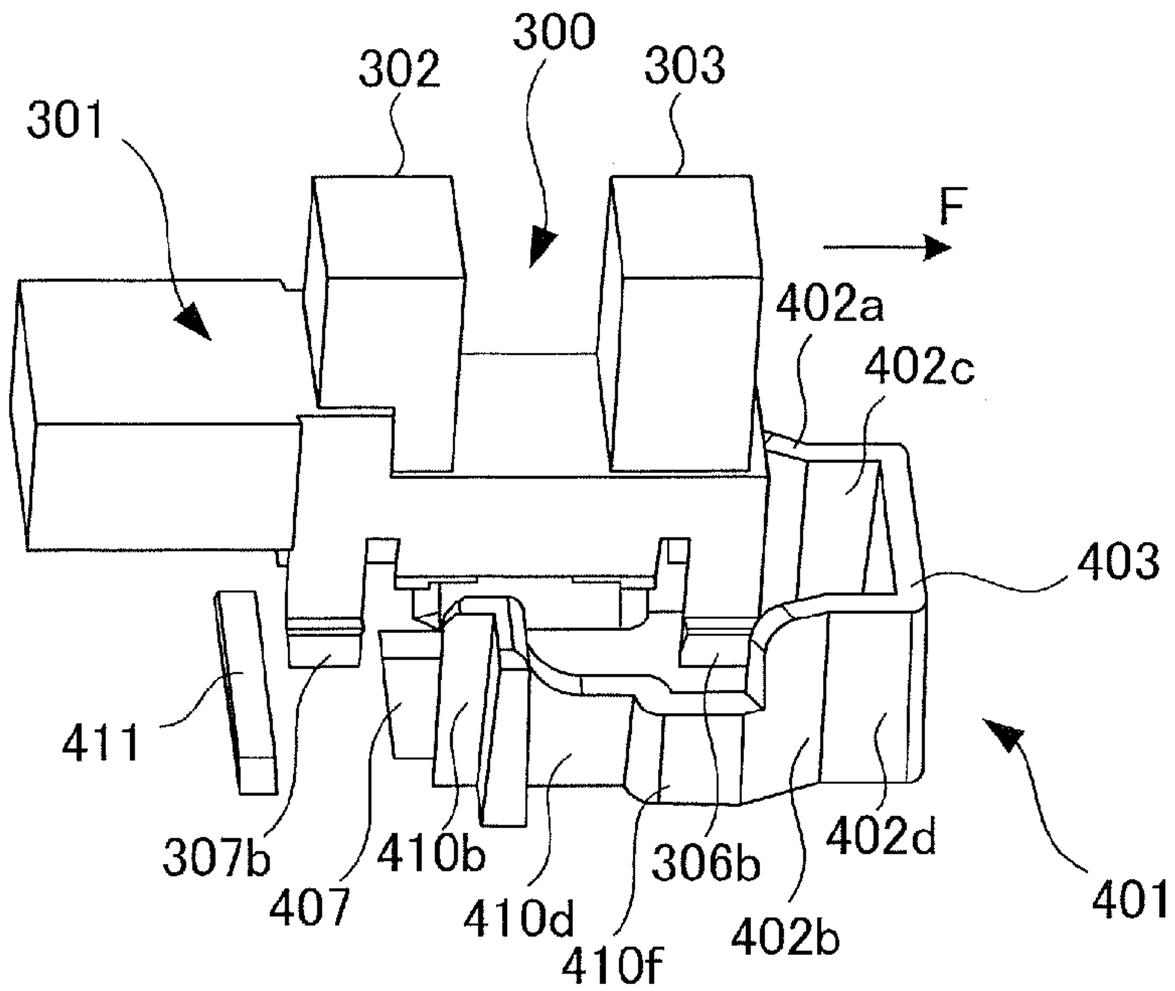
JP 2018-034935 A 3/2018

Primary Examiner — David H Banh
(74) *Attorney, Agent, or Firm* — Venable LLP

(57) **ABSTRACT**

A photo-interruptor unit includes a photo-interruptor and a supporting portion to detachably support the photo-interruptor. The supporting portion includes a hole which is formed on an attaching surface and through which a hook portion is inserted, and a guide portion to protrude from the attaching surface and guide the hook portion so that it deforms in a deformation direction when the photo-interruptor is moved in a movement direction intersecting an insertion direction. A regulating portion protrudes from the attaching surface and forms continuously with the guide portion to regulate a position in the movement direction of the photo-interruptor. The guide portion includes a first rib portion and a second rib portion that oppose one another in the deformation direction, and a distance between the first rib portion and the second rib portion in the deformation direction narrows toward a downstream direction of the movement direction.

12 Claims, 9 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0065818	A1*	3/2006	Shimokawa	G01V 8/20 250/221
2008/0210952	A1*	9/2008	Wada	H01L 31/0203 257/82
2015/0157196	A1*	6/2015	Van Der Mark	H01R 43/002 134/104.1
2018/0059601	A1*	3/2018	Abe	G03G 21/16

* cited by examiner

FIG.1

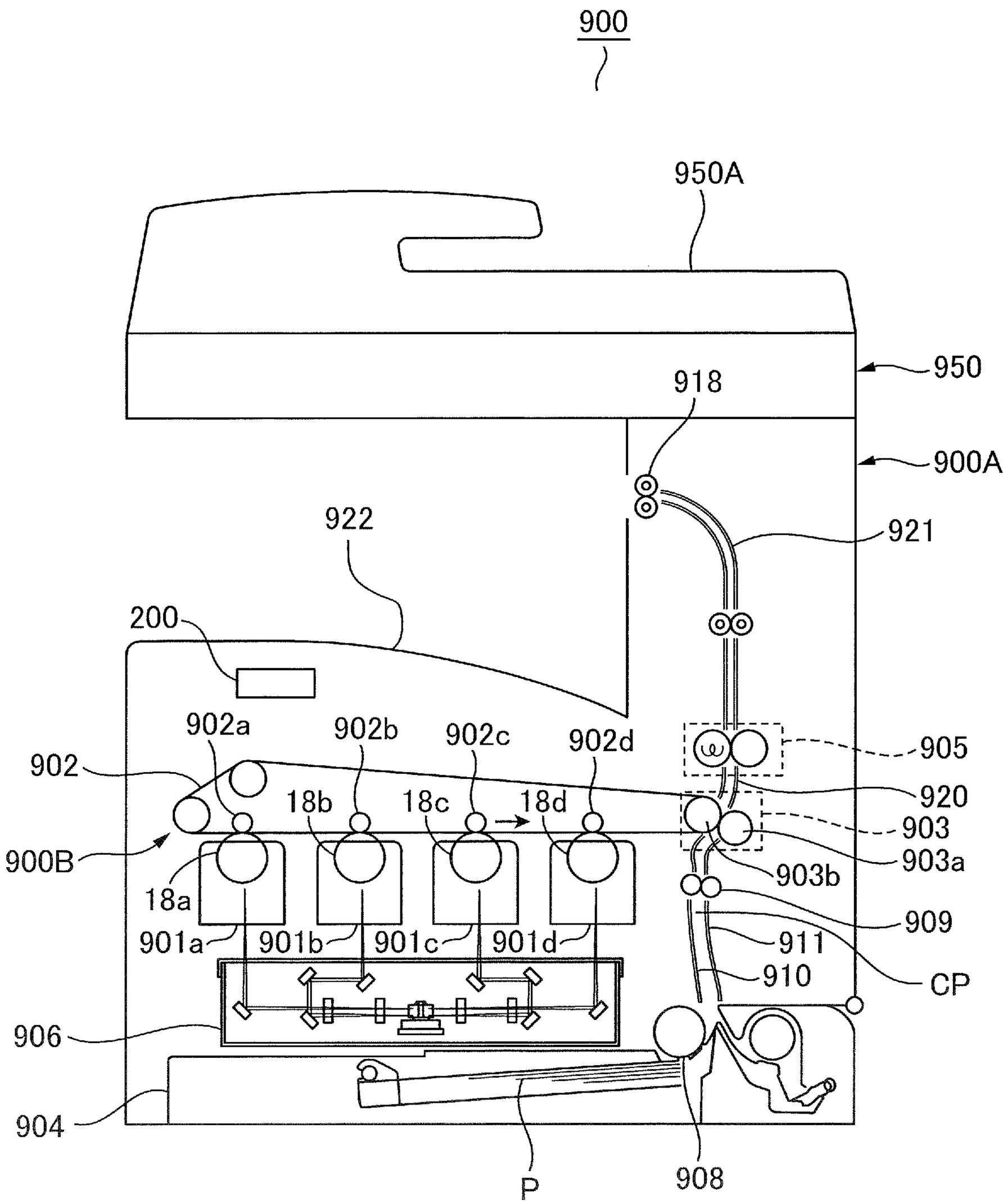

900
950A
950
918
900A
922
921
200
902a
902b
902c
902d
905
902
920
903
18b
18c
18d
900B
903a
903b
18a
909
901a
901b
901c
901d
911
910
CP
906
904
P
908

FIG.2A

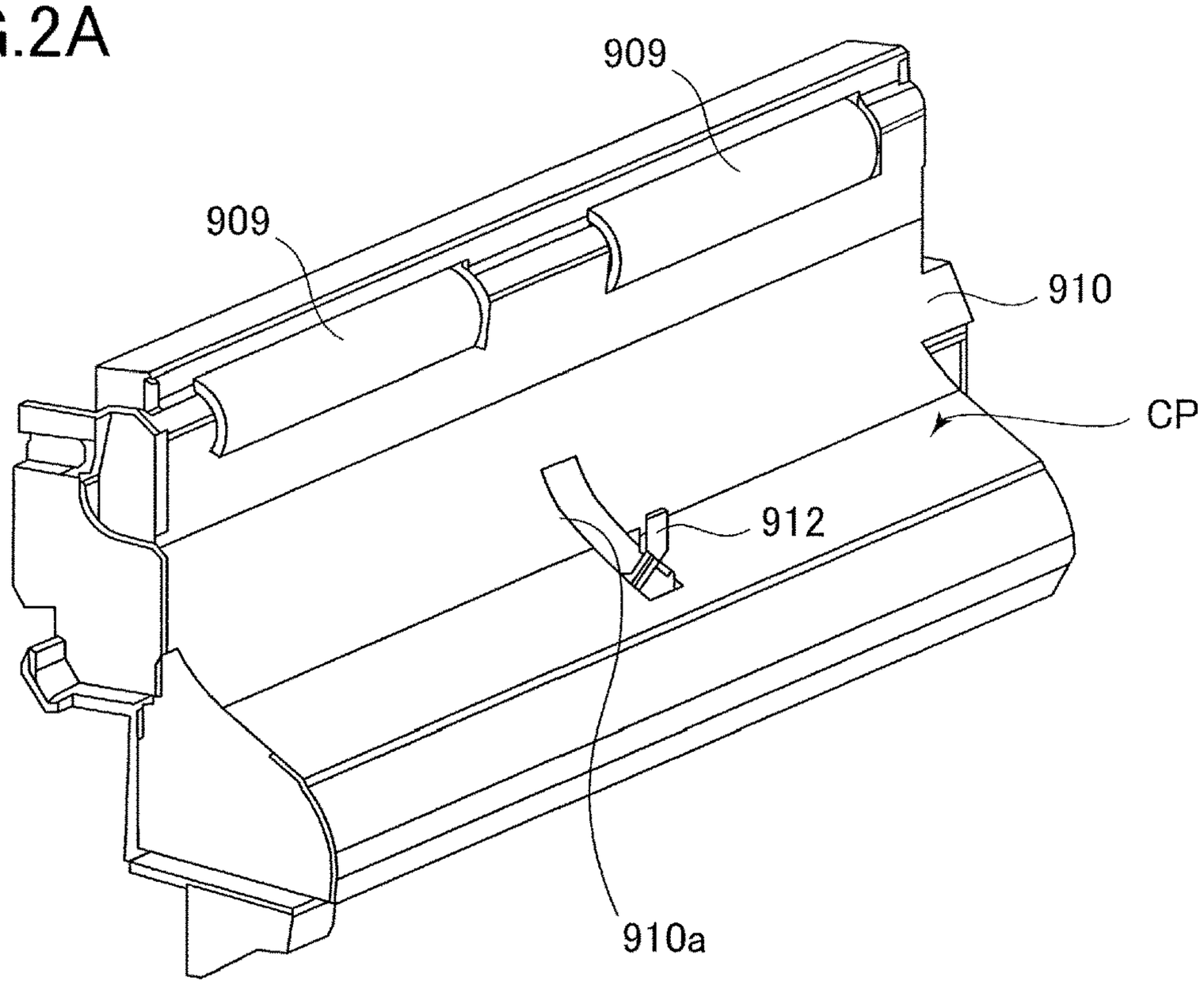

909
909
910
CP
912
910a

FIG.2B

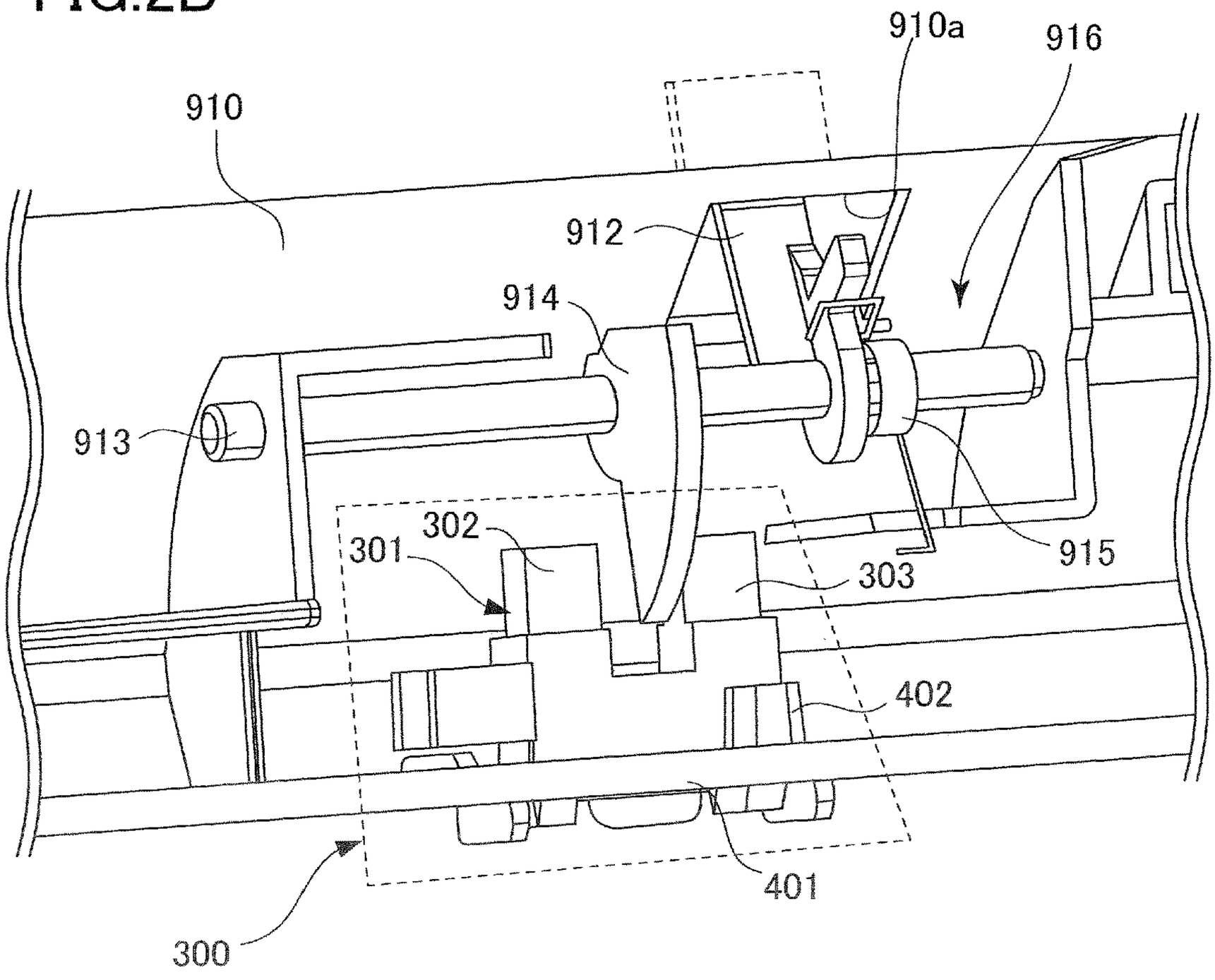

910a
916
910
912
914
913
302
301
303
915
402
401
300

FIG.3A

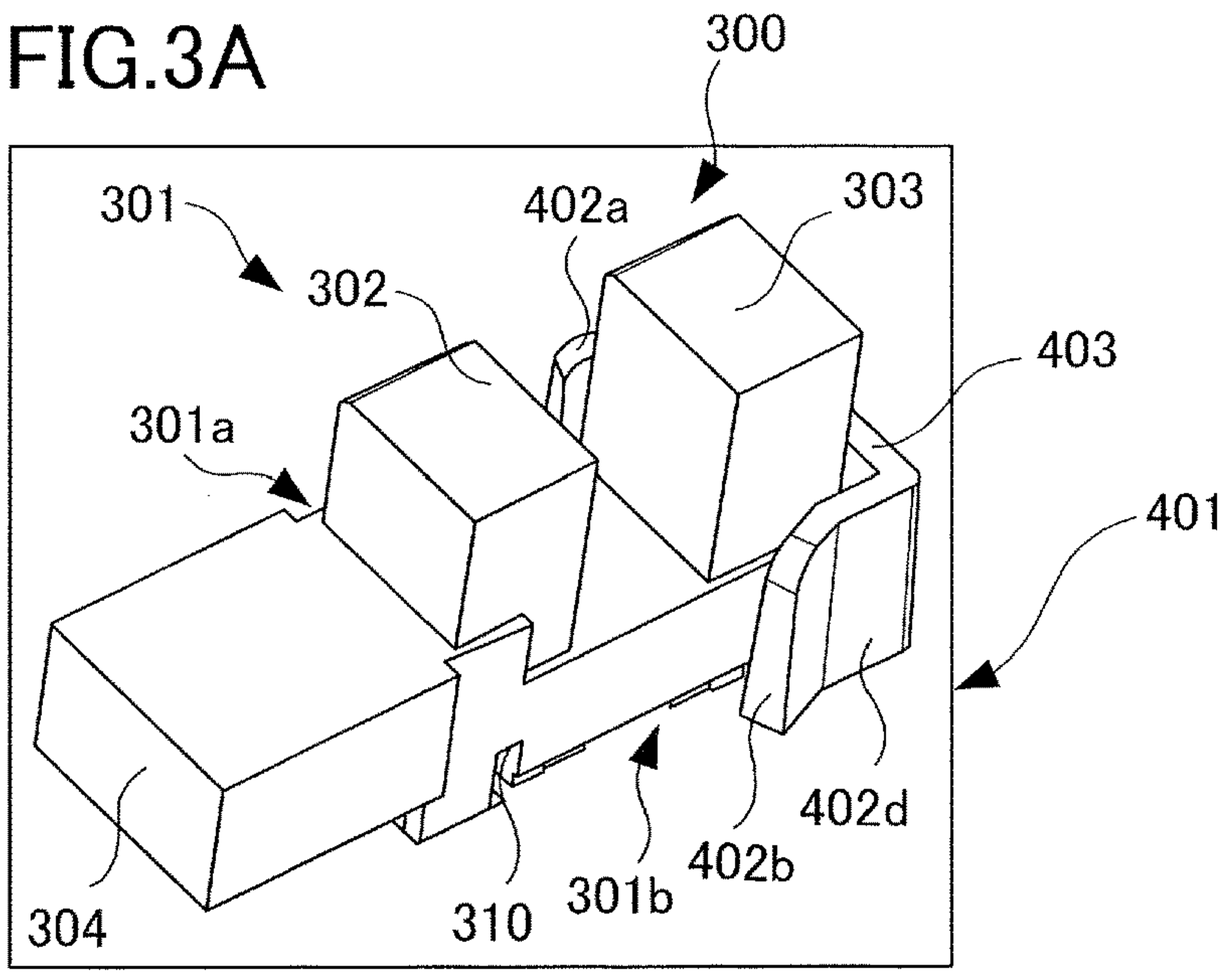


FIG.3B

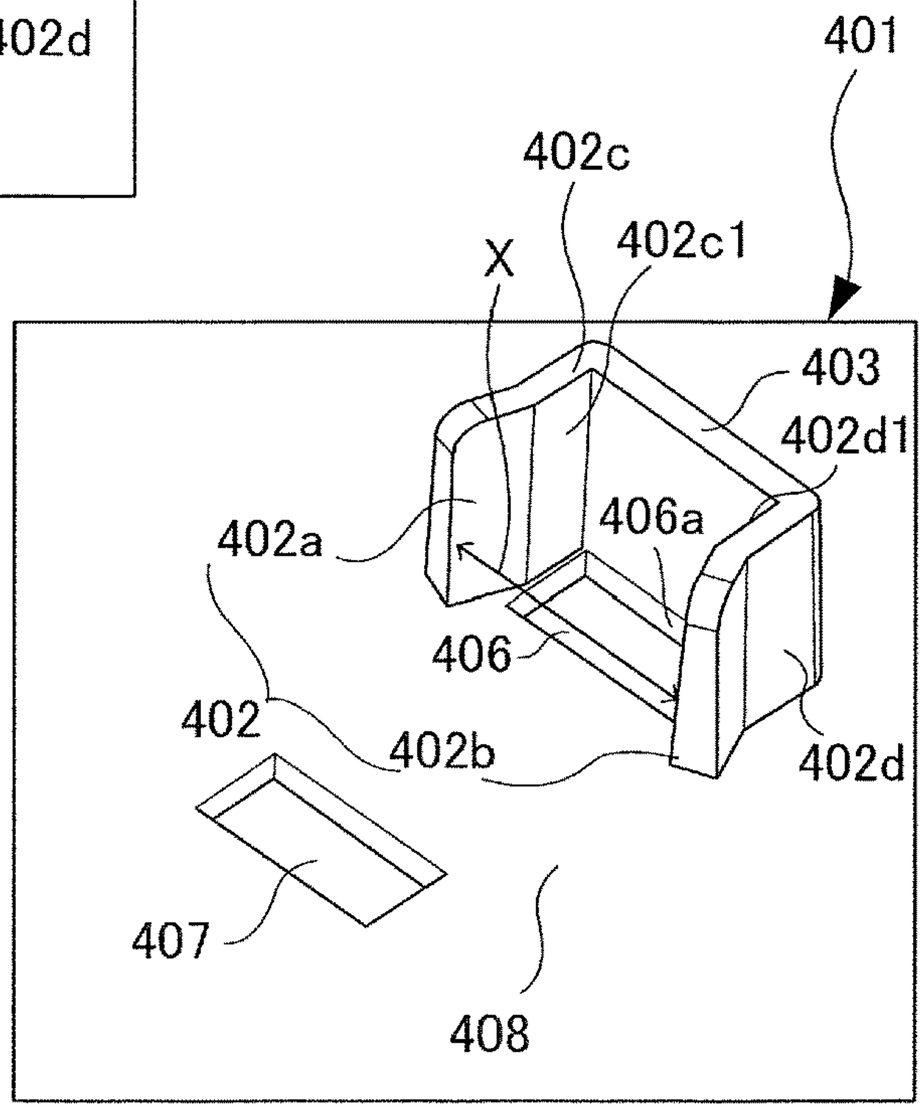


FIG.3C

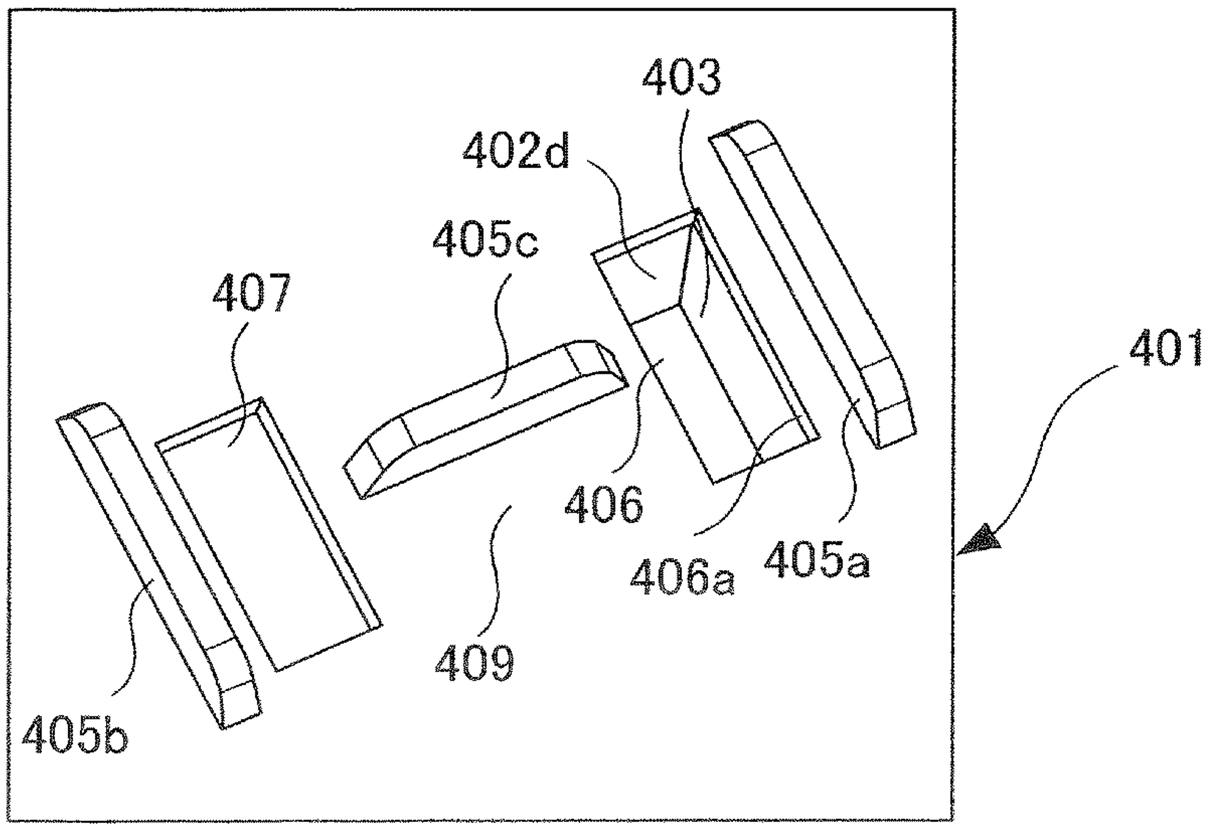


FIG.4A

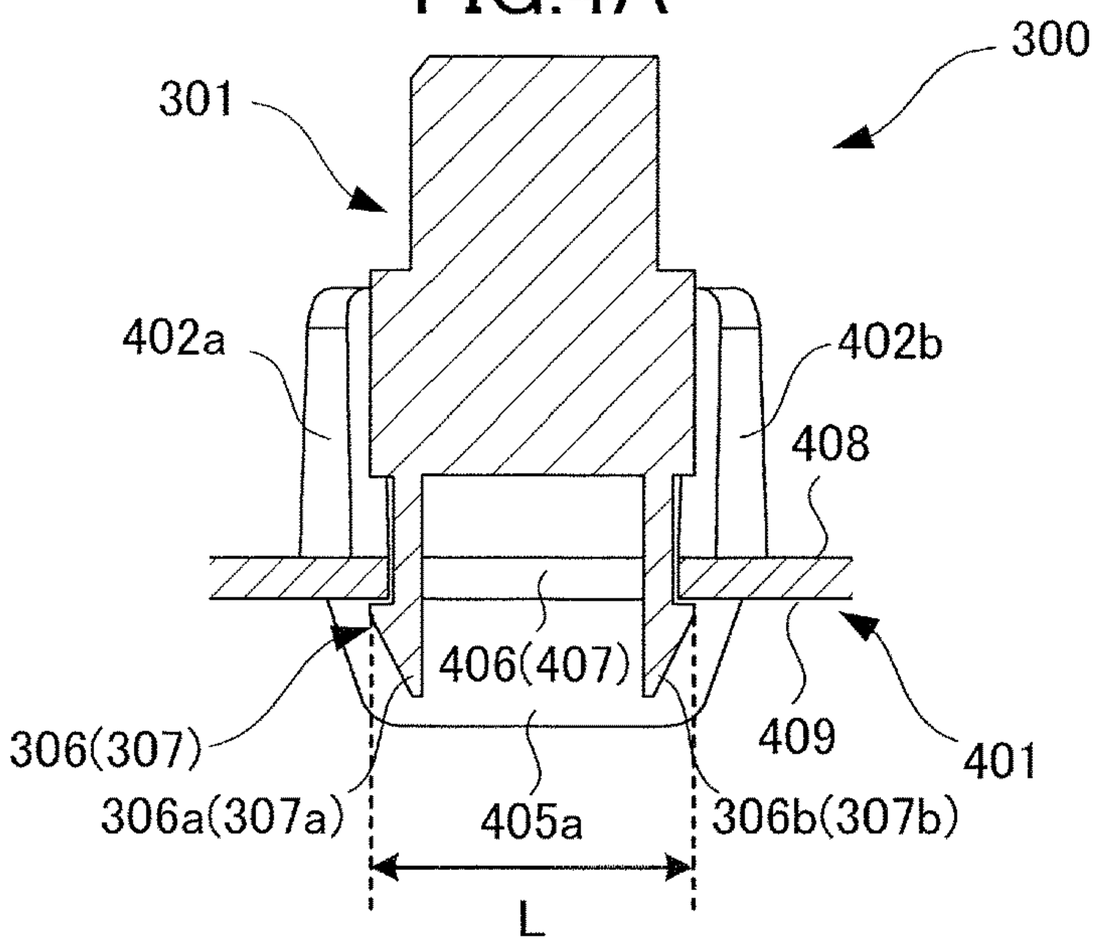


FIG.4B

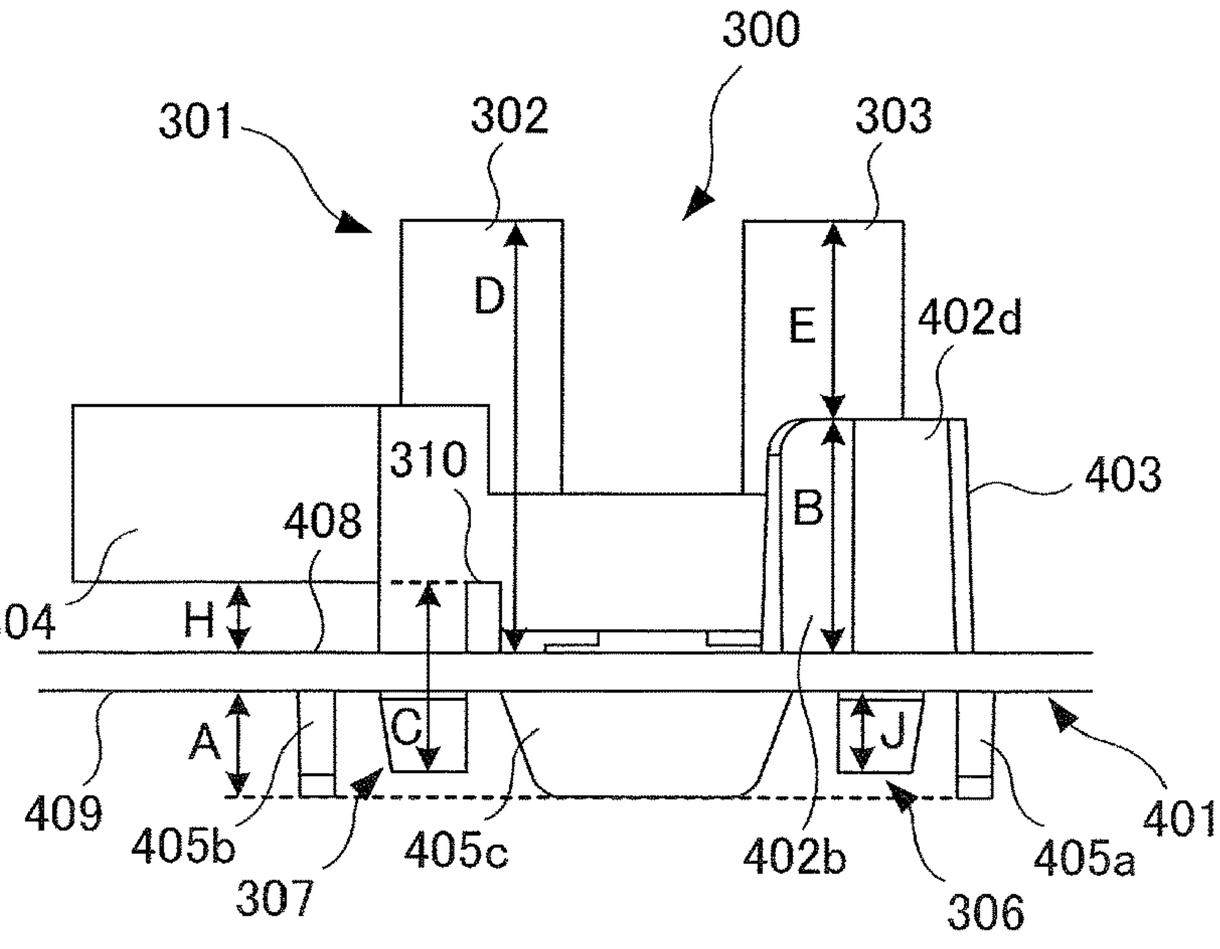
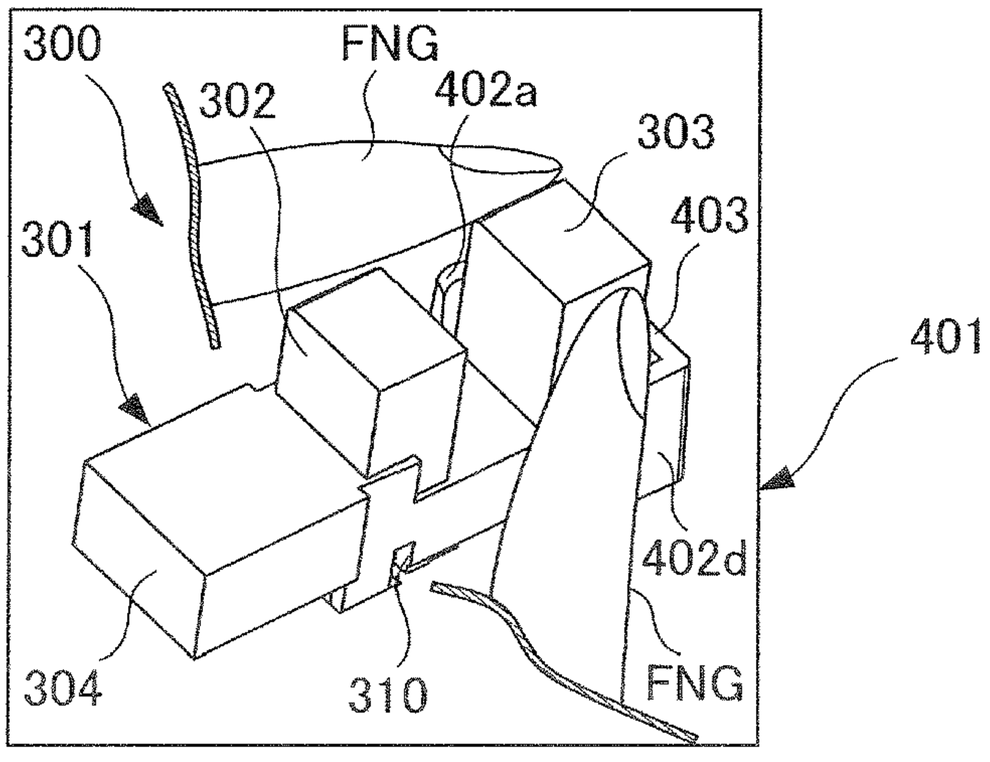


FIG.4C



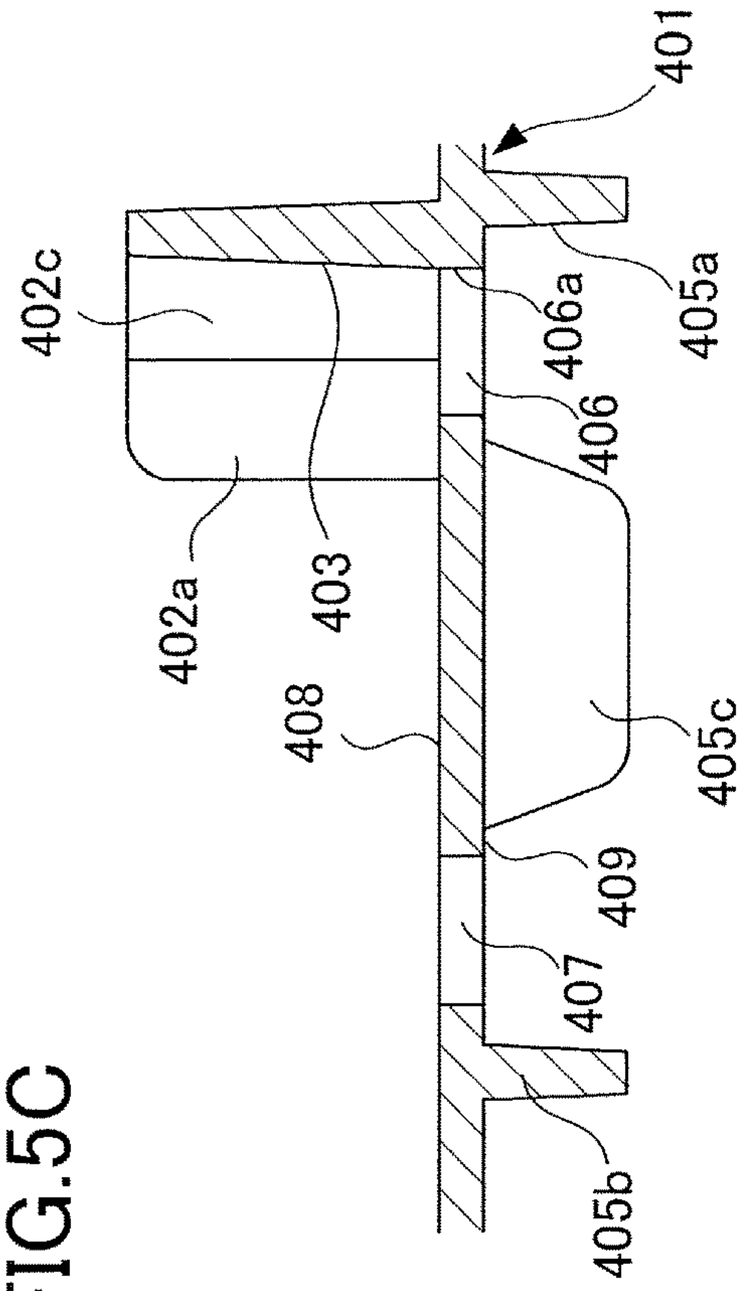


FIG.5C

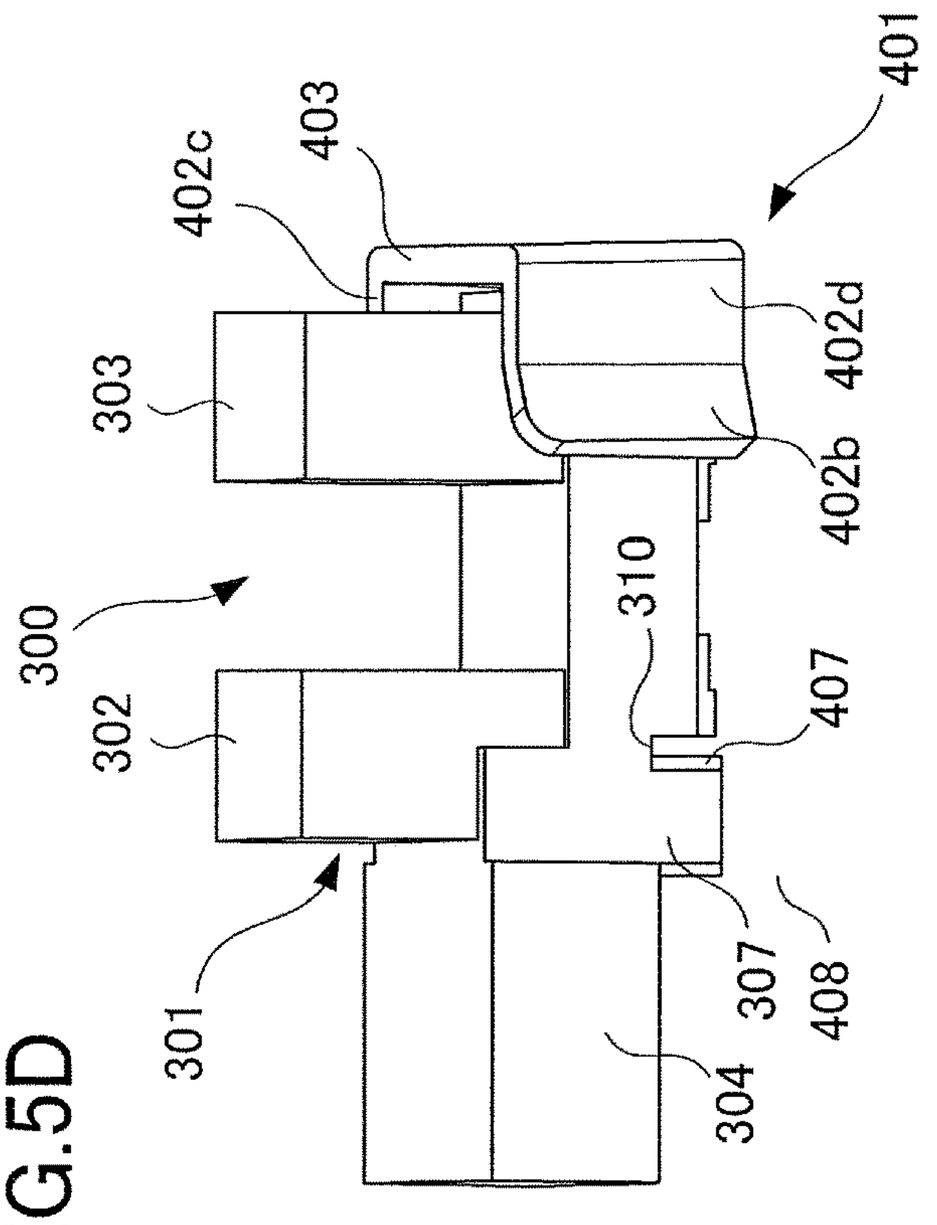


FIG.5D

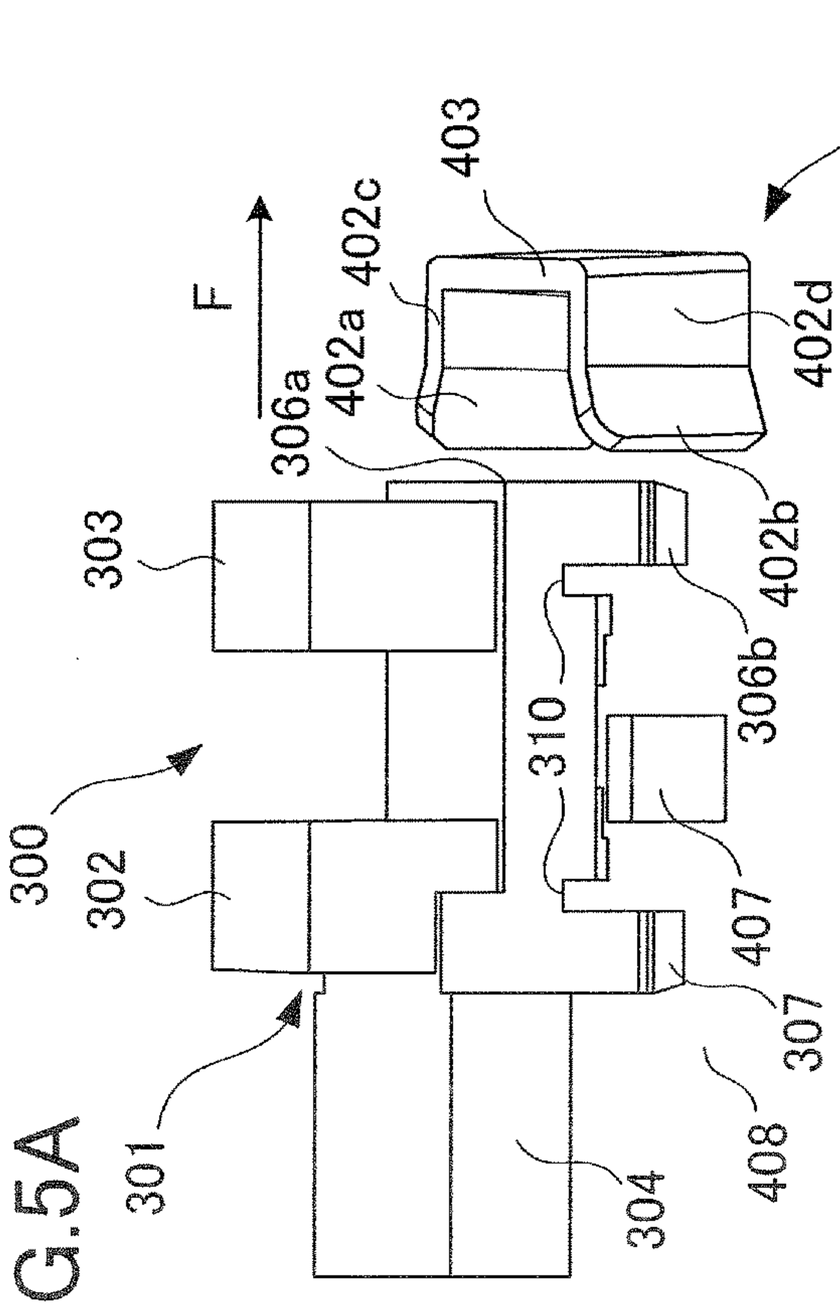


FIG.5A

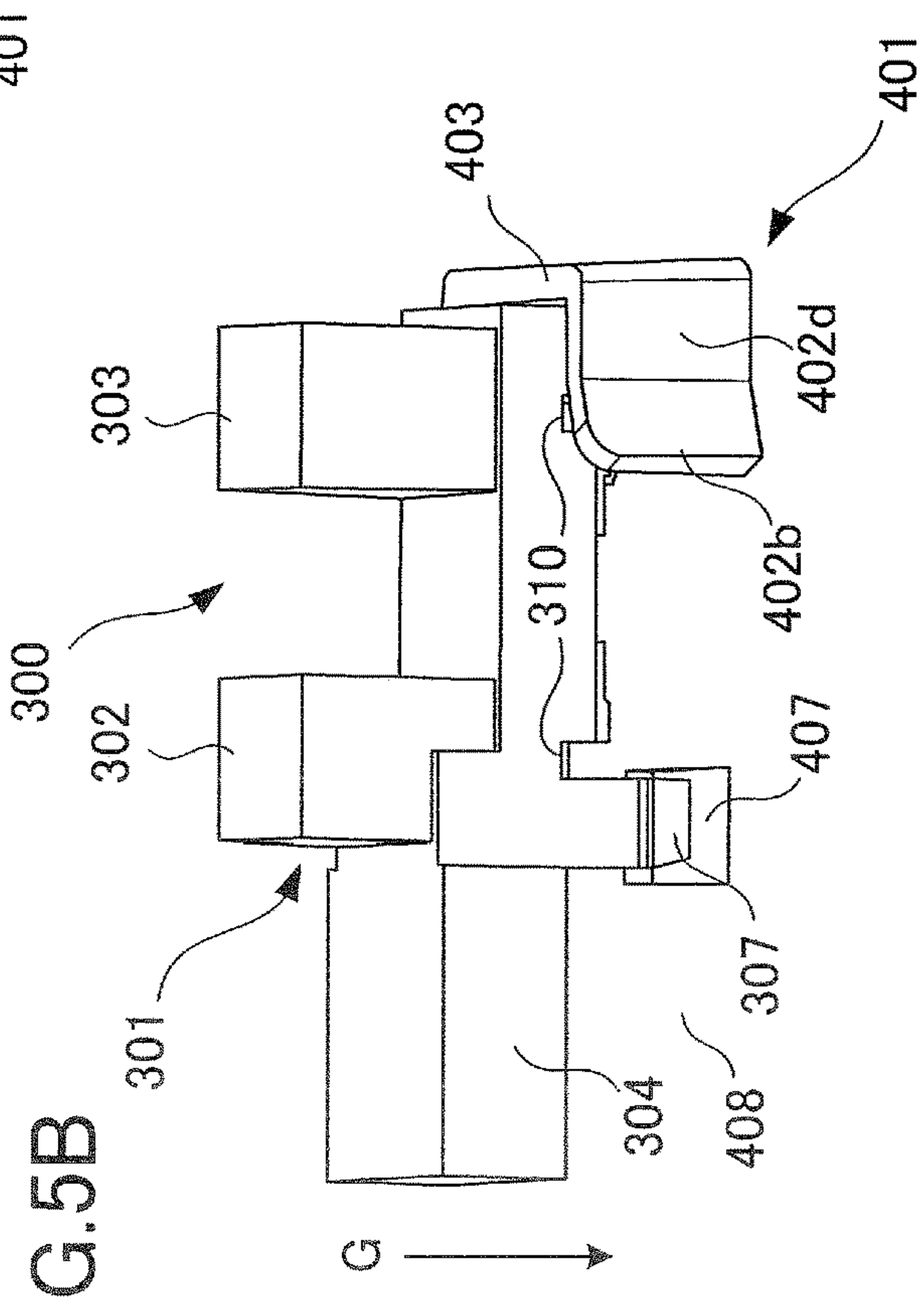


FIG.5B

FIG.6A

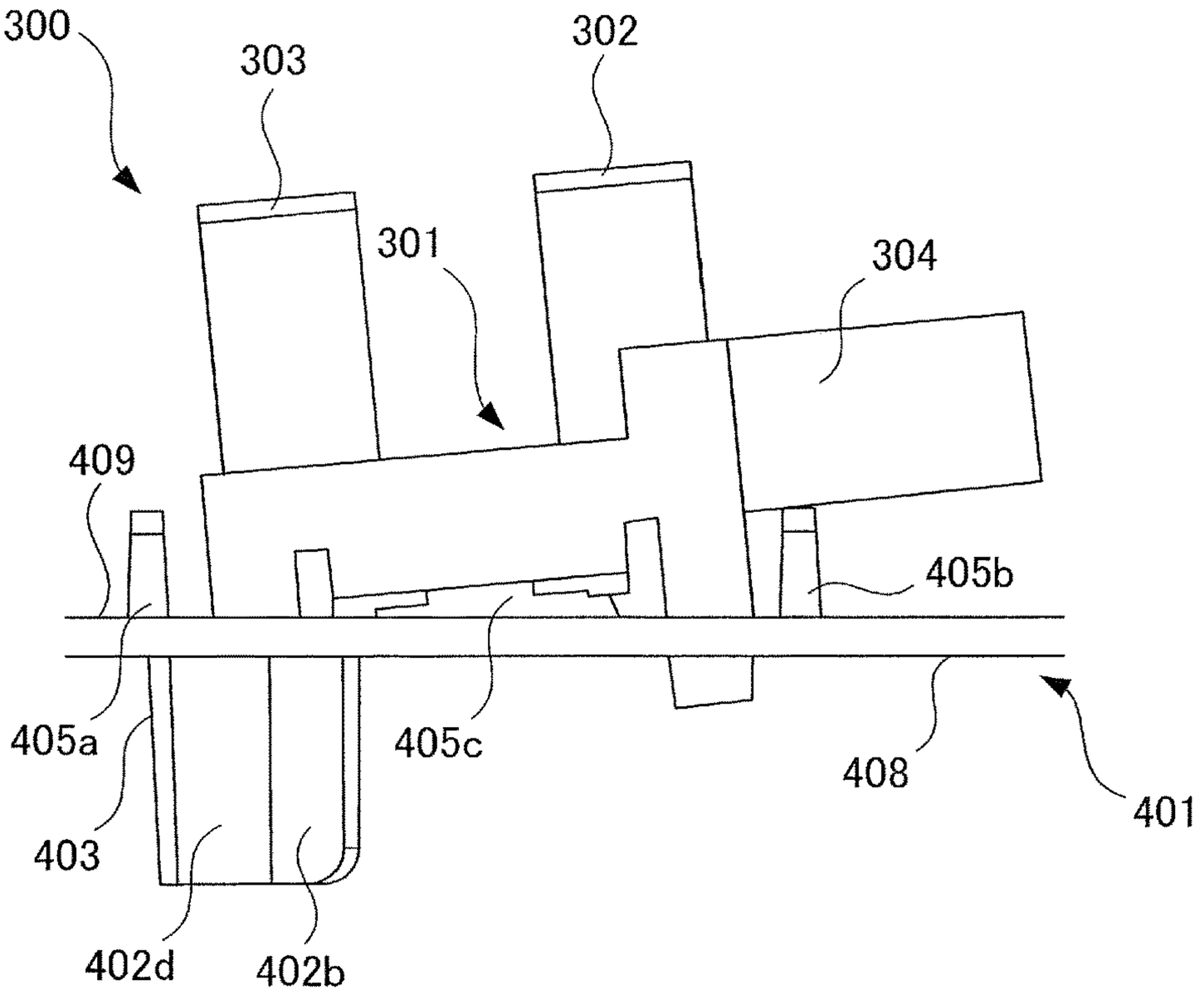

300
303
302
301
304
409
405b
405a
405c
408
401
403
402d
402b

FIG.6B

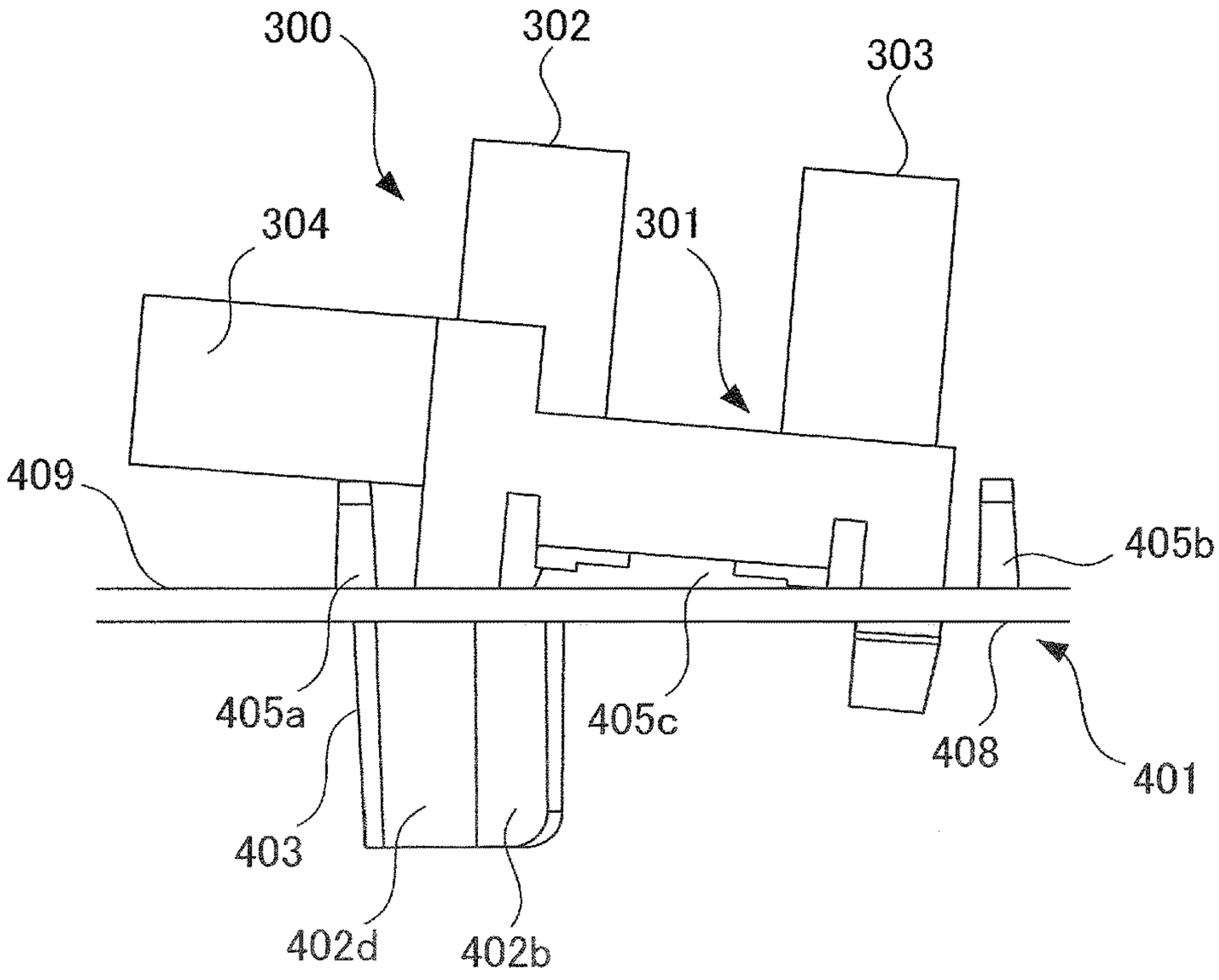

300
302
303
304
301
409
405b
405a
405c
408
401
403
402d
402b

FIG.7A

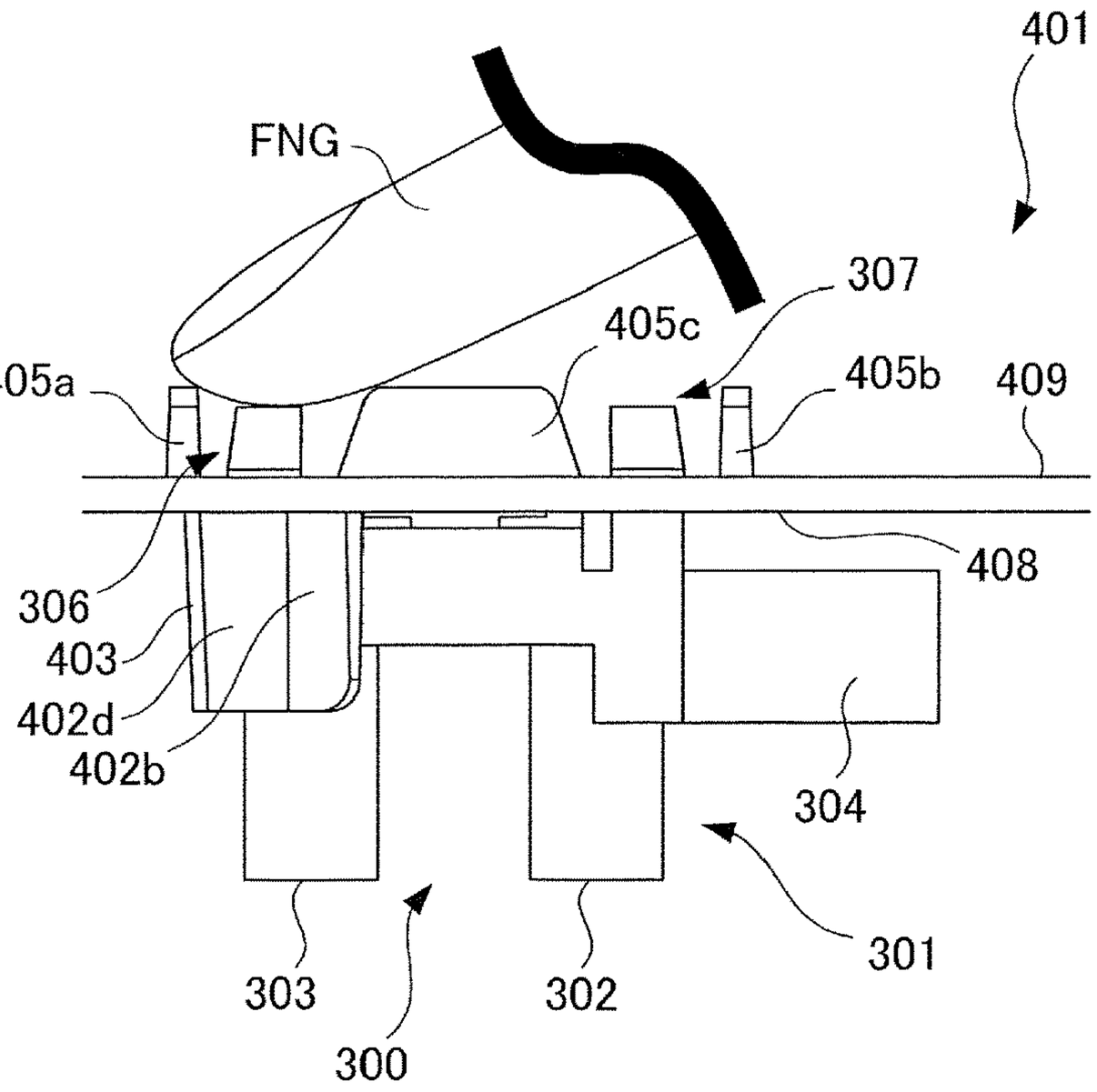

401
FNG
307
405c
405a
405b
409
306
403
402d
402b
408
304
303
300
302
301

FIG.7B

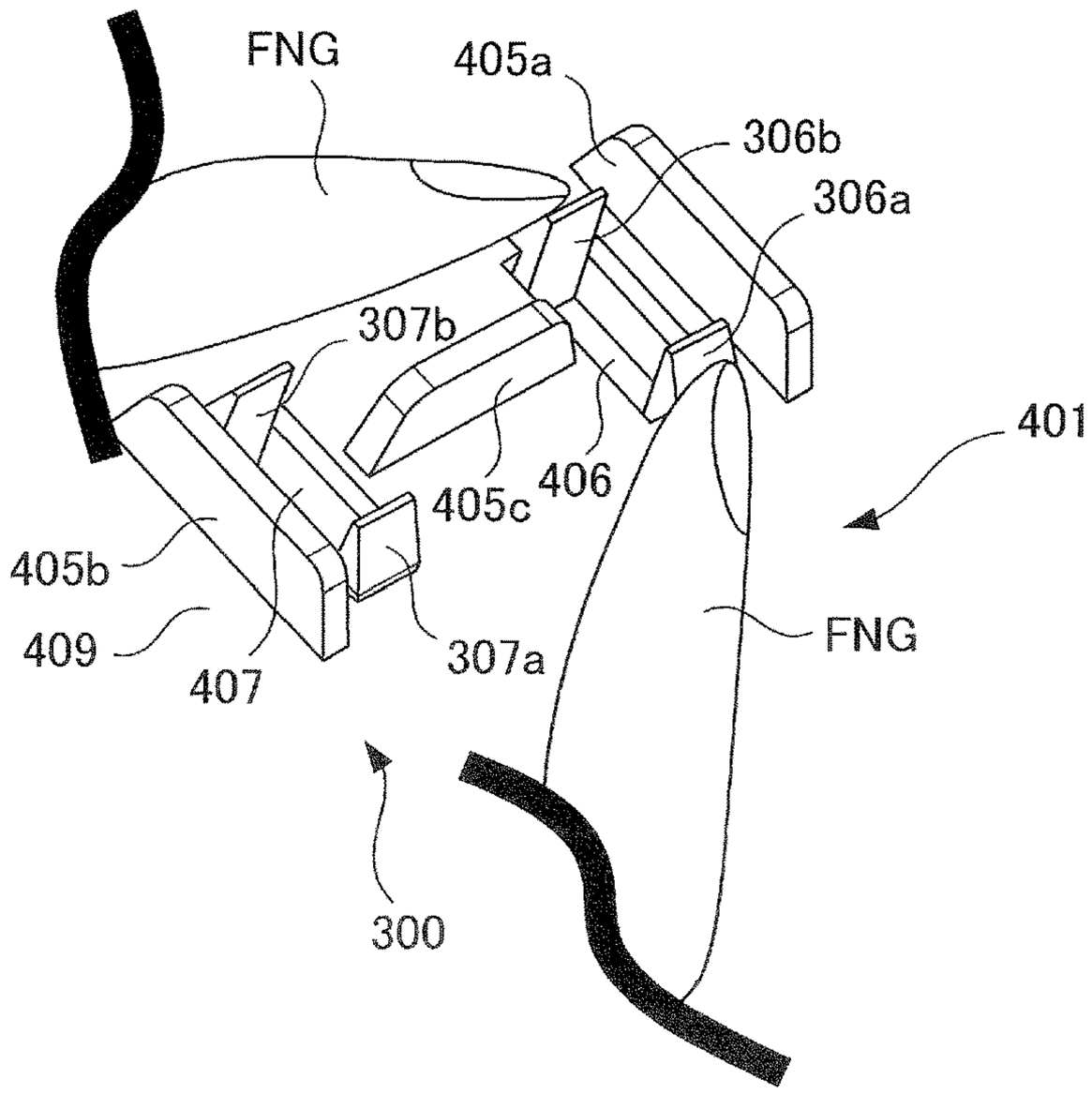

FNG
405a
306b
306a
307b
401
405c
406
405b
409
407
307a
FNG
300

FIG.8A

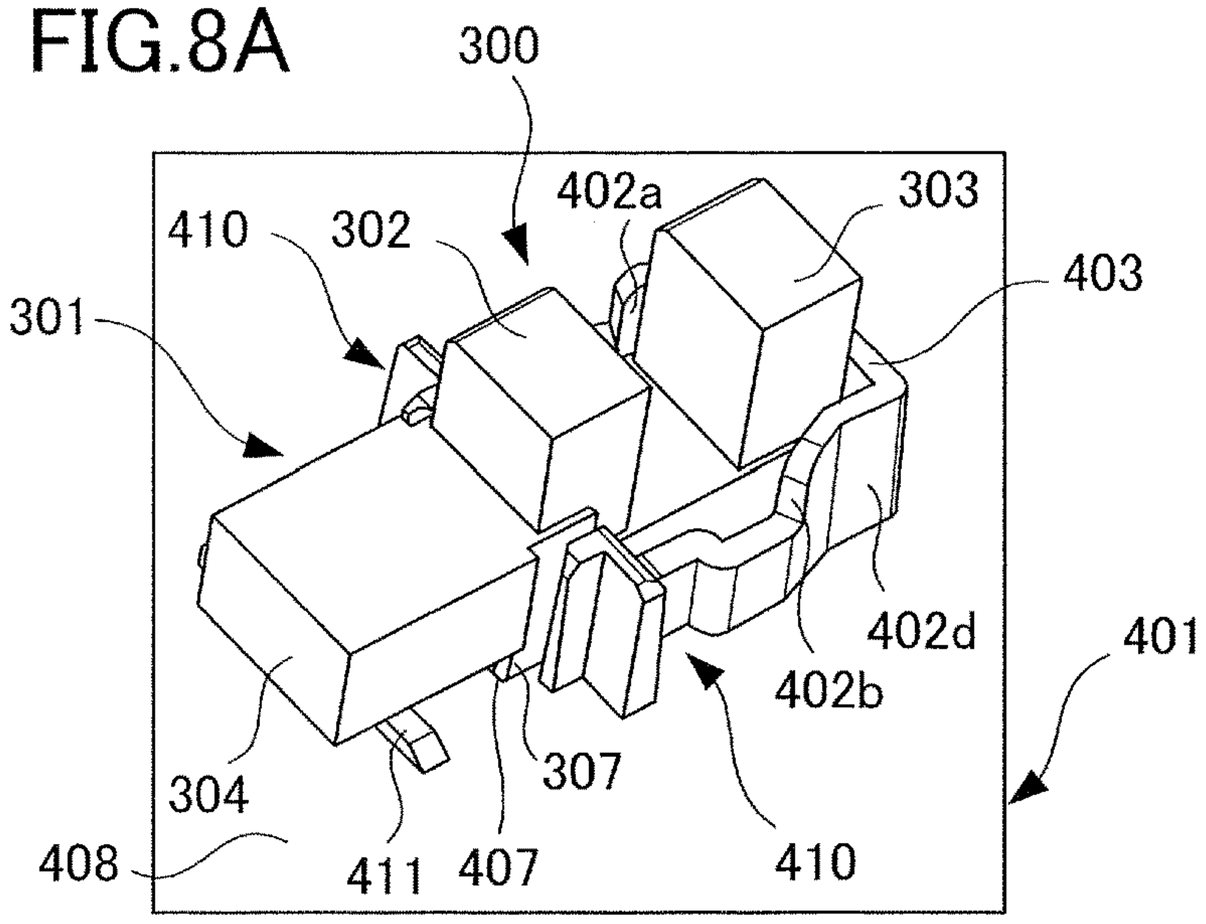


FIG.8B

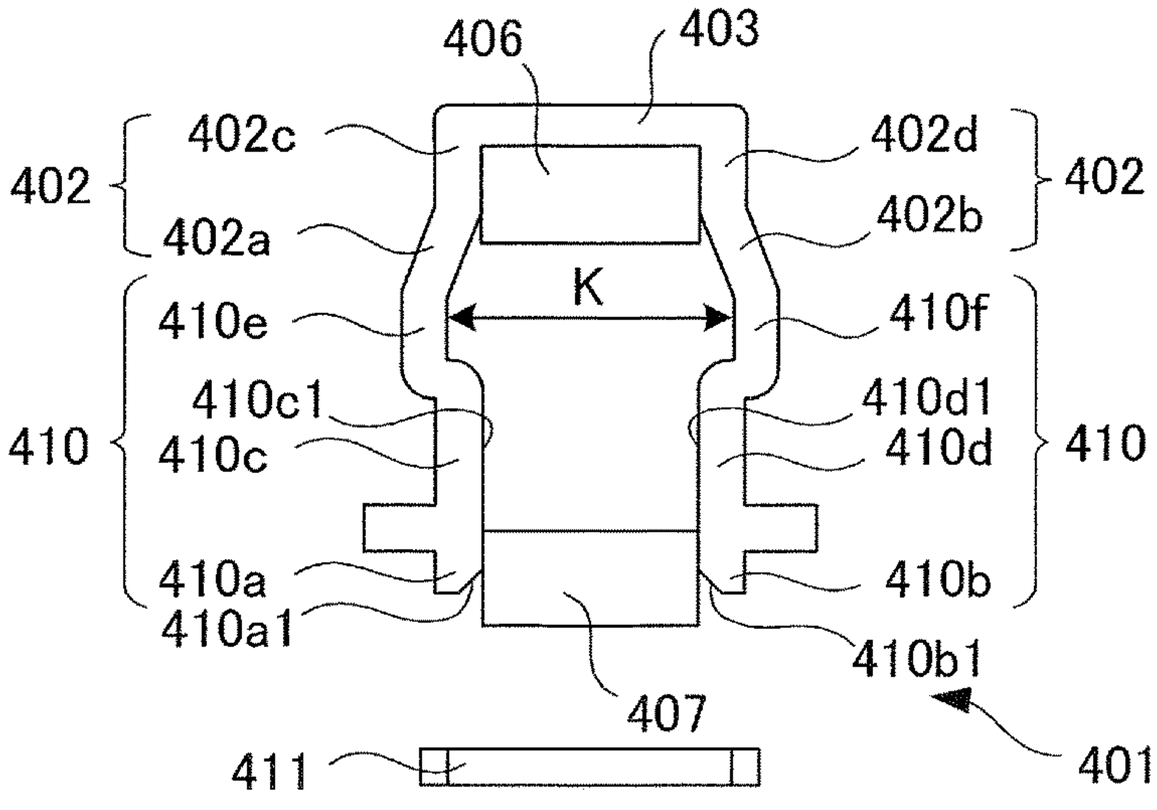


FIG.8C

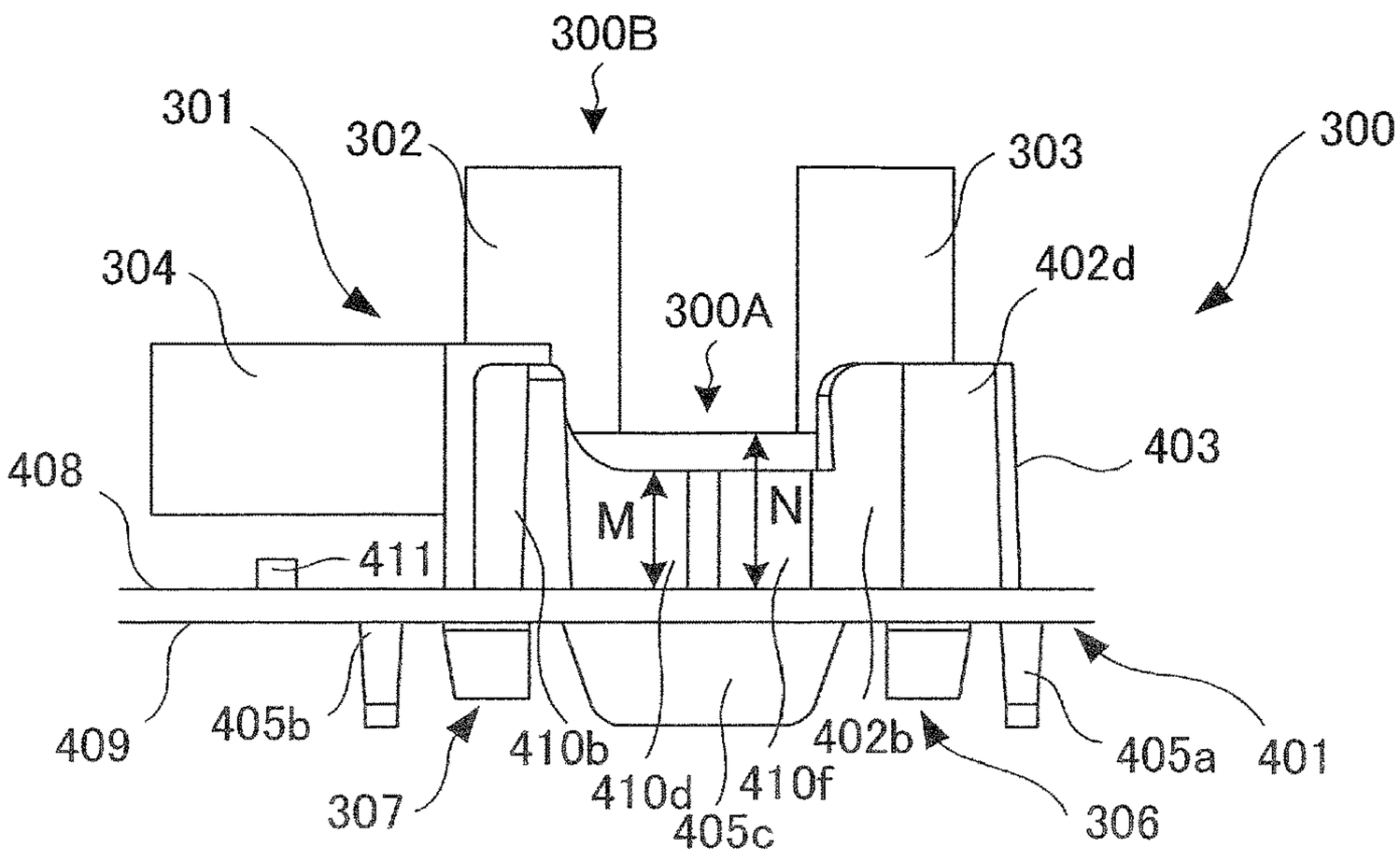


FIG.9A

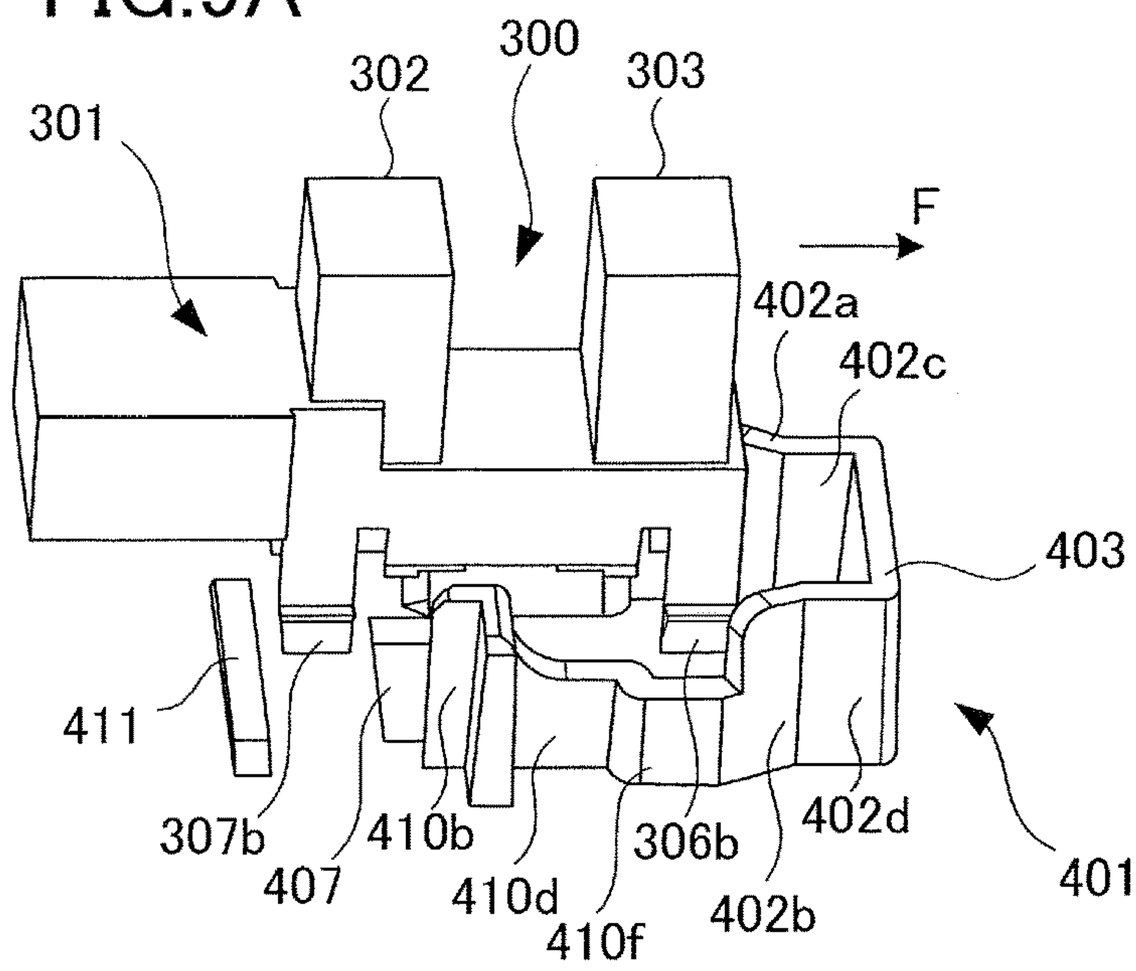


FIG.9B

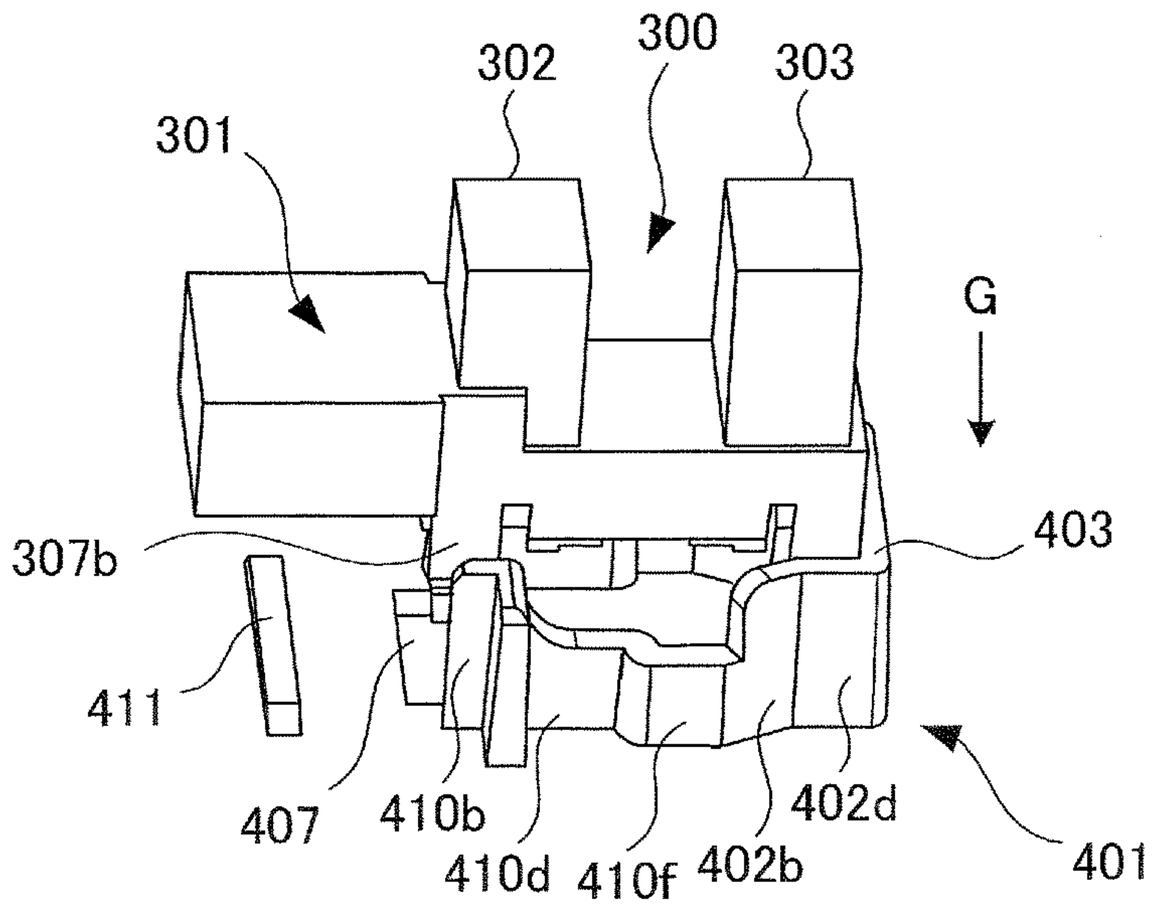


FIG.9C

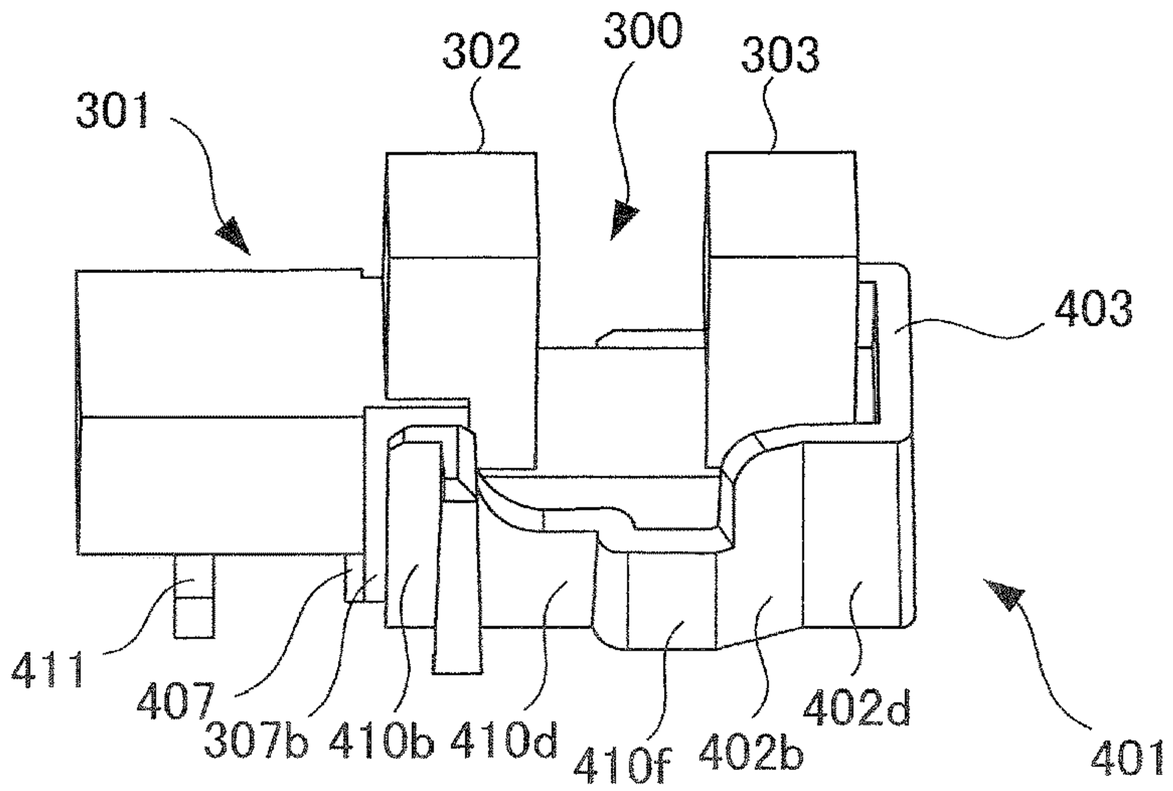


PHOTO-INTERRUPTOR UNIT, SHEET CONVEYANCE APPARATUS AND IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a photo-interruptor unit including a photo-interruptor, a sheet conveyance apparatus and an image forming apparatus equipped with the same.

Description of the Related Art

Generally, a photo-interruptor provided on an apparatus such as a pachinko game machine, a camera or a printer is known to detect the presence of a detection target by switching light irradiated from a light emitting component between a state reaching a photosensing portion and a state not reaching the same. One example of a photo-interruptor provided on a printer is a photo-interruptor that detects the presence of a sheet by blocking light emitted from the light emitting component to the photosensing portion by a flag that moves by being pressed by a sheet being conveyed. The photo-interruptor is fixed by an elastically deformable hook portion being fit to an engagement hole by so-called snap-fitting.

In mass production processing of snap-fitting the hook portion, if external force is applied unintentionally by an operator to the photo-interruptor that has been engaged properly, engagement failure may occur where the snap-fit photo-interruptor is disengaged or semi-engaged. If this engagement failure is revealed after completing assembling of associated parts, the unit including the photo-interruptor must be discarded as a defective product or the unit must be disassembled and reassembled, so that there was much loss and deterioration of productivity.

Meanwhile, Japanese Patent Application Laid-Open Publication No. 2018-34935 discloses a photo-interruptor unit having a guide rib provided on a side surface of a photo-interruptor, and capable of suppressing engagement failure of snap-fitting caused by external force. Specifically, in Japanese Patent Application Laid-Open Publication No. 2018-34935, the position of the photo-interruptor receiving external force in a short length direction of the photo-interruptor may be regulated by being abutted against a guide rib, and thereby, disengagement of snap-fitting is suppressed.

The photo-interruptor unit disclosed in Japanese Patent Application Laid-Open Publication No. 2018-34935 enables to suppress disengagement of the photo-interruptor after the fitting operation. However, if the snap-fitting component is erroneously bumped against an area close to the engagement hole during snap-fitting to the engagement hole, the snap-fitting component may be bent or damaged.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, a photo-interruptor unit includes a photo-interruptor including a light emitting component configured to emit light, a photosensing portion configured to receive light emitted from the light emitting component, and a hook portion configured to deform elastically in a deformation direction, and a supporting portion configured to detachably support the photo-interruptor. The supporting portion includes an attaching surface to which the photo-interruptor is attached, a hole which is formed on the attaching surface and through which the hook portion is inserted in an insertion direction, a guide portion configured to protrude from the attaching surface and configured to guide the hook portion so that the hook portion deforms in the deformation direction in a state where the photo-interruptor is moved in the deformation direction and a movement direction intersecting the insertion direction to be attached to the supporting portion, and a regulating portion configured to protrude from the attaching surface and configured to regulate a position in the movement direction of the photo-interruptor whose hook portion has been guided by the guide portion to a position where the hook portion is overlapped with the hole.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a general schematic view of a printer according to a first embodiment.

FIG. **2**A is a perspective view of a conveyance guide and a sensor flag.

FIG. **2**B is a perspective view illustrating the sensor flag from a rear side.

FIG. **3**A is a view illustrating an attaching portion in a state where a photo-interruptor is attached.

FIG. **3**B is a perspective view illustrating an attaching portion in a state where the photo-interruptor is removed.

FIG. **3**C is a perspective view illustrating the attaching portion from a rear side.

FIG. **4**A is a cross-sectional view of the photo-interruptor unit.

FIG. **4**B is a side view of the photo-interruptor unit.

FIG. **4**C is an explanatory view of an attachment process of the photo-interruptor unit by an operator.

FIG. **5**A is a perspective view illustrating a method for inserting the photo-interruptor to the attaching portion.

FIG. **5**B is a perspective view illustrating a method for engaging the photo-interruptor to the attaching portion.

FIG. **5**C is a cross-sectional view of an attaching portion.

FIG. **5**D is a perspective view illustrating a state where the photo-interruptor is attached.

FIG. **6**A is a cross-sectional view illustrating an example in which the photo-interruptor is attached from a rear side.

FIG. **6**B is a cross-sectional view illustrating another example of a state where the photo-interruptor is attached from a rear side.

FIG. **7**A is a cross-sectional view illustrating a state where an operator has contacted a hook portion from a rear side.

FIG. **7**B is an explanatory view of a detachment process of the photo-interruptor by an operator.

FIG. **8**A is a view illustrating an attaching portion according to a second embodiment in a state where a photo-interruptor is attached.

FIG. **8**B is an upper view illustrating a state where the photo-interruptor is detached.

FIG. **8**C is an upper view illustrating a state where the photo-interruptor is detached.

FIG. **9**A is a perspective view illustrating a method of inserting the photo-interruptor according to the second embodiment to an attaching portion.

FIG. **9**B is a perspective view illustrating a method for engaging the photo-interruptor to the attaching portion.

FIG. **9**C is a view illustrating a state where the photo-interruptor is attached.

DESCRIPTION OF THE EMBODIMENTS

First Embodiment

Overall Configuration

FIG. **1** is an entire schematic diagram illustrating a configuration of a printer of an electrophotographic system according to a first embodiment. As illustrated in FIG. **1**, a printer **900**, i.e., image forming apparatus, includes a printer main body, hereinafter referred to as apparatus body **900**A including an image forming unit **900**B for forming an image on a sheet, and an image reading apparatus **950** including a document conveyance apparatus **950**A.

Now, the image forming unit **900**B includes photosensitive drums **18***a*-**18***d* that forms toner images of four colors, which are yellow, magenta, cyan and black, and an exposing unit **906** that forms an electrostatic latent image on a photosensitive drum by irradiating laser beams based on image information. The photosensitive drums **18***a*-**18***d* are driven by a motor not shown, and on the circumference of each photosensitive drum is arranged a primary charger, a developer and a transfer charger, which are formed into units as process cartridges **901***a*-**901***d*.

Further, the image forming unit **900**B includes an intermediate transfer belt **902** which is driven to rotate in an arrow direction in FIG. **1**, and a secondary transfer portion **903** for transferring a full-color image formed on the intermediate transfer belt **902** to a sheet P. By applying transfer bias to the intermediate transfer belt **902** from transfer chargers **902***a*-**902***d*, toner images of respective colors on the photosensitive drum are transferred in multiple layers on the intermediate transfer belt **902**. Thereby, a full-color image is formed on the intermediate transfer belt **902**.

The secondary transfer portion **903** is composed of a secondary transfer counter roller **903***b* configured to support the intermediate transfer belt **902**, and a secondary transfer roller **903***a* that abuts against the secondary transfer counter roller **903***b* via the intermediate transfer belt **902**. Further, a sheet feeding cassette **904** is arranged below the image forming unit **900**B, and the sheet P stacked on the sheet feeding cassette **904** is fed by a pickup roller **908** that serves as a conveyance portion configured to convey a sheet according to the present embodiment. Further, a registration roller **909** is provided downstream in the conveyance direction of the pickup roller **908**. A control unit **200** is provided on the apparatus body **900**A.

Next, an image forming operation of the printer **900** configured as above will be described. In a state where the image forming operation is started, the exposing unit **906** irradiates laser beams based on image information from a personal computer and the like not shown, by which the photosensitive drums **18***a*-**18***d* whose surfaces are charged uniformly are exposed sequentially to form electrostatic latent images on the photosensitive drums **18***a*-**18***d*. Thereafter, the electrostatic latent images are developed by toner and visualized.

For example, a laser beam based on an image signal corresponding to yellow color component in the document is irradiated on the photosensitive drum **18***a* using a polygon mirror and the like of the exposing unit **906**. A yellow electrostatic latent image is developed using yellow toner from the developer and visualized as yellow toner image. Thereafter, the toner image reaches a primary transfer portion where the photosensitive drum **18***a* and the intermediate transfer belt **902** contact each other by rotation of the photosensitive drum **18***a*. In a state where the toner image reaches the primary transfer portion, primary transfer bias applied to the transfer charger **902***a* causes the yellow toner image on the photosensitive drum **18***a* to be transferred to the intermediate transfer belt **902**.

Next, similarly as the method described above, magenta toner image, cyan toner image and black toner image formed on the photosensitive drums **18***b*-**18***d* are transferred on top of the yellow toner image borne on the intermediate transfer belt **902**. Thereby, a full-color toner image is formed on the intermediate transfer belt **902**.

Further, simultaneously as the toner image forming operation, the sheet P stored in the sheet feeding cassette **904** is sent out one sheet at a time by the pickup roller **908**. Then, the sheet P passes between the conveyance guides **910** and **911** to reach the registration roller **909**, where skewing of the sheet P is corrected by the registration roller **909**, and then the sheet is conveyed to the secondary transfer portion **903**. Thereafter, in the secondary transfer portion **903**, the toner images of four colors formed on the intermediate transfer belt **902** are collectively transferred to the sheet P by secondary transfer bias applied on the secondary transfer roller **903***a*.

Next, the sheet P to which the toner image has been transferred is guided from the secondary transfer portion **903** to a conveyance guide **920** and conveyed to a fixing portion **905**, and when passing through the fixing portion **905**, the sheet receives heat and pressure by which the toner image is fixed. Thereafter, the sheet P to which the toner image has been fixed passes through a sheet discharge conveyance guide **921** provided downstream of the fixing portion **905** in a conveyance direction, and thereafter, the sheet is discharged onto a sheet discharge tray **922** by a sheet discharge roller pair **918**.

Photo-Interruptor and Flag Unit

FIG. **2**A is a perspective view illustrating the conveyance guide **910**, the registration roller **909** and a pressing portion **912**. For better understanding, the opposing registration roller and other components are not shown in the drawing. FIG. **2**B is a view illustrating a flag unit **916** from a rear side.

As illustrated in FIG. **2**B, the conveyance guide **910** has an attaching portion **401** serving as a supporting portion of the present embodiment formed integrally thereto, and a photo-interruptor **301** is detachably attached to the attaching portion **401**. The photo-interruptor **301** includes a light emitting component **302** having a light emitting element arranged on an inner side thereof, and a photosensing portion **303** retaining a photosensing element on an inner side thereof.

Further, the flag unit **916** serving as a moving unit according to the present embodiment is attached to the conveyance guide **910**. The flag unit **916** includes a pivot shaft **913** supported rotatably on the conveyance guide **910**, and a pressing portion **912** and a flag portion **914** respectively integrally fixed to the pivot shaft **913**. The pressing portion **912** is protruded through a long hole **910***a* formed on the conveyance guide **910** to a conveyance path CP formed of the conveyance guides **910** and **911** (refer to FIG. **1**). The flag portion **914** is formed to enter between the light emitting component **302** and the photosensing portion **303** and block the light emitted from the light emitting component **302**. The flag unit **916** is formed so that the pressing portion **912** is protruded to the conveyance path CP by a torsion spring **915** attached to the pivot shaft **913**, and the flag portion **914** is urged to a pivot angle so as not to block the light emitted from the light emitting component **302**. If there is no sheet

in the conveyance path CP, the photo-interruptor **301** is in a photosensing state in which the light emitted from the light emitting component **302** is sensed by the photosensing portion **303**.

Then, in a state where the pressing portion **912** is pressed by the sheet conveyed by the pickup roller **908** and passed through the conveyance path CP, the flag portion **914** pivots together with the pivot shaft **913** against the urging force of the torsion spring **915**. Then, the light emitted from the light emitting component **302** to the photosensing portion **303** is blocked by the flag portion **914**. That is, if a sheet is present in the conveyance path CP, the photo-interruptor **301** is in a blocked state where the light emitted from the light emitting component **302** to the photosensing portion **303** is blocked.

As described, it is detected that a leading edge of the sheet P has reached a position of the pressing portion **912** by the photo-interruptor **301** switching from a photosensing state to a blocked state, and a detection signal is output. Further, in a state where the trailing edge of the sheet P being conveyed passes through the pressing portion **912**, the flag portion **914** pivots together with the pivot shaft **913** by the urging force of the torsion spring **915**, and the photo-interruptor **301** is switched from the blocked state to the photosensing state. Thereby, it is detected that the trailing edge of the sheet P has passed the position of the pressing portion **912**, and a detection signal is output. The pickup roller **908**, the flag unit **916** and a photo-interruptor unit **300** described later constitutes a sheet conveyance apparatus that conveys sheets.

Detailed Configuration of Photo-Interruptor Unit

FIG. **3**A is a perspective view illustrating the photo-interruptor unit **300** configured by attaching the photo-interruptor **301** to the attaching portion **401**. FIG. **3**B is a perspective view in which the attaching portion **401** to which the photo-interruptor **301** is attached is viewed from a side having an attaching surface **408**. FIG. **3**C is a perspective view illustrating the attaching portion **401** from a rear side **409**. In FIGS. **3**A to **3**C, a portion of the attaching portion **401** is cut away in the drawing.

As illustrated in FIG. **3**A, the photo-interruptor **301** includes a connector portion **304** that is electrically connected with the control unit **200** (refer to FIG. **1**) through wiring, wherein the connector portion **304**, the light emitting component **302** and the photosensing portion **303** are arranged in line along a longitudinal direction, that is, movement direction. A plurality of connector pins (not shown) are arranged on an inner side of the connector portion **304**. An exterior of the photo-interruptor **301** composed of the connector portion **304**, the light emitting component **302** and the photosensing portion **303**, with a first hook portion **306** and a second hook portion **307** described later, is formed by a resin having elasticity, such as polycarbonate. The second hook portion is arranged closer to the connector portion than the first hook portion in the movement direction and configured to deform elastically in the deformation direction.

As illustrated in FIG. **3**B, the attaching portion **401** includes the attaching surface **408** to which the photo-interruptor **301** is attached. The attaching surface **408** includes a first engagement hole **406**, also referred to as hole or first hole, and a second engagement hole **407**, also referred to as second hole, which are aligned in the longitudinal direction. A first guide rib **402**, also referred to as guide portion or first guide portion, and a regulation rib **403** are protruded from the attaching surface **408** in a direction perpendicular to the attaching surface **408**. The first guide rib **402** includes a pair of guide ribs **402***a*, **402***b* serving as first rib portion and second rib portion, and the guide ribs **402***a* and **402***b* are arranged in a short length direction, that is, deformation direction shown by arrow X of FIG. **3**B, which is orthogonal to the longitudinal direction, with a distance therebetween. Further, the guide ribs **402***a* and **402***b* are designed so that the distance therebetween in the short length direction is narrowed as it approaches the regulation rib **403** in the longitudinal direction. That is, the distance between the first rib portion and the second rib portion in the deformation direction is configured to be narrowed toward a downstream direction of the movement direction. Further, the first guide rib **402** includes guide ribs **402***c* and **402***d*. In a state where the distance therebetween in the short length direction is narrowed for a predetermined amount, the guide ribs **402***a* and **402***b* are respectively connected to the guide ribs **402***c* and **402***d*.

The guide ribs **402***c* and **402***d* are arranged parallel with respect to the longitudinal direction with a distance therebetween in the short length direction, at a position downstream of the guide ribs **402***a* and **402***b* and upstream of the regulation rib **403** in the movement direction. By having the photo-interruptor **301** inserted between the guide ribs **402***a* and **402***b*, the first hook portion **306** described later is deformed in the deformation direction. By moving the photo-interruptor **301** toward the regulation rib **403**, the first hook portion **306** is further deformed by the guide ribs **402***a* and **402***b* into a shape capable of being engaged with an edge of the first engagement hole **406**. The regulation rib **403** serving as a regulating portion according to the present embodiment extends in a short length direction so as to be connected to a first end portion of the pair of guide ribs **402***c* and **402***d*, and a first end thereof is connected continuously to an engagement wall **406***a* of an engagement hole **406**. Thereby, if the regulation rib **403** and the photo-interruptor **301** are abutted against one another, the position of the photo-interruptor **301** in the movement direction is regulated to a position where the first hook portion **306** is overlapped with the engagement hole **406**. By inserting the first hook portion **306** to the first engagement hole **406** in a state where the photo-interruptor **301** is regulated by the regulation rib **403**, the first hook portion **306** is engaged with the edge of the first engagement hole **406**. As described, the photo-interruptor **301** is attached to the attaching portion **401**.

In a state where the photo-interruptor **301** is attached to the attaching portion **401**, the guide ribs **402***a*, **402***b*, **402***c* and **402***d* are opposed to side surfaces **301***a* and **301***b* of the photo-interruptor **301**. In this state, the gap formed between a pair of guide ribs **402***a* and **402***b* with the side surfaces **301***a* and **301***b* opposed thereto is narrowed toward the regulation rib **403** in the longitudinal direction. Further, the guide ribs **402***c* and **402***d* serving as the position regulating portion according to the present embodiment are respectively formed with a slight gap formed between the side surfaces **301***a* and **301***b*. Side surfaces **402***c***1** and **402***d***1** of the guide ribs **402***c* and **402***d* are opposed to the side surfaces **301***a* and **301***b* at a distance of a same length as the gap between the guide ribs **402***a* and **402***b* and the side surfaces **301***a* and **301***b* most downstream in the movement direction. The side surfaces **402***c***1** and **402***d***1**, i.e., position regulating surfaces, are opposed to the photo-interruptor **301** and regulates the position of the photo-interruptor **301** in the short length direction.

As illustrated in FIG. **3**C, rear side ribs **405***a*, **405***b* and **405***c* serving as opposite surface-side ribs are protruded perpendicularly with respect to the rear side **409** from the rear side **409** which is a side opposite to the attaching surface **408** of the attaching portion **401**. The first engagement hole **406** and the second engagement hole **407** are formed to pass

through from the attaching surface **408** to the rear side **409** between the rear side ribs **405***a* and **405***b*. Further, the rear side rib **405***c* is provided at a position between the first engagement hole **406** and the second engagement hole **407**, and it is arranged orthogonally with respect to the rear side ribs **405***a* and **405***b*.

FIG. **4**A is a cross-sectional view illustrating a state in which the photo-interruptor **301** is attached to the attaching portion **401**. FIG. **4**B is a side view illustrating a state in which the photo-interruptor **301** is attached to the attaching portion **401**. FIG. **4**C is a perspective view illustrating a step in which the operator attaches the photo-interruptor **301**. As illustrated in FIGS. **4**A and **4**B, the photo-interruptor **301** includes the first hook portion **306** and the second hook portion **307** which are respectively engageable with the first engagement hole **406** and the second engagement hole **407**. The first hook portion **306** and the second hook portion **307** have hook shapes formed at the leading edges thereof. By inserting the first hook portion **306** and the second hook portion **307** to the first engagement hole **406** and the second engagement hole **407**, the hook shapes of the first hook portion **306** and the second hook portion **307** are respectively engaged with the edges of the first engagement hole **406** and the second engagement hole **407**. As described, the photo-interruptor **301** is attached to the attaching portion **401**. The first hook portion **306**, the second hook portion **307**, the first engagement hole **406** and the second engagement hole **407** adopt a so-called snap-fitting configuration. The first hook portion **306** and the second hook portion **307** are formed to have a same shape.

The first hook portion **306** includes a pair of hooks **306***a* and **306***b* that are arranged in parallel in the deformation direction. The pair of hooks **306***a* and **306***b* are formed of resin so that it is elastically deformable in the deformation direction of the first hook portion **306**, that is, in right and left directions of FIG. **4**A. The pair of hooks **306***a* and **306***b* in a non-elastically deformed state is arranged at a position interposed between the guide ribs **402***a* and **402***b*. That is, a distance X between upstream ends of the guide ribs **402***a* and **402***b* in the movement direction of the photo-interruptor **301** is greater than the distance between the pair of hooks **306***a* and **306***b* in a non-elastically deformed state. That is, the distance in the deformation direction between the upstream end of the first rib portion in the movement direction and the upstream end of the second rib portion in the movement direction is greater than the distance between the pair of hooks that are not in an elastically deformed state at a most distant position in the deformation direction. The second hook portion **307** includes a pair of hooks **307***a* and **307***b*, and the pair of hooks **307***a* and **307***b* is formed of resin so that they are elastically deformable in the deformation direction. The pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* include tapered portions formed on outer sides thereof in the short length direction.

When attaching the photo-interruptor **301** to the attaching portion **401**, the tapered portions of the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* contact the attaching portion **401**. When the tapered portions of the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* abut against the attaching portion **401**, the hooks **306***a* and **306***b* and the hooks **307***a* and **307***b* are bent inward in the short length direction of the photo-interruptor **301**. That is, in a state where the photo-interruptor **301** is attached to the attaching portion **401**, the deformation direction of the first hook portion **306** and the second hook portion **307** is the short length direction of the photo-interruptor **301**. Thereafter, the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* are further inserted until the hook shapes formed on the leading edges of the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* are inserted to the first engagement hole **406** and the second engagement hole **407**. Thereby, the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* are restored to their original shapes and are engaged with the edges of the first engagement hole **406** and the second engagement hole **407**, as illustrated in FIGS. **4**A to **4**C, by which the photo-interruptor **301** is attached to the attaching portion **401**. The state in which the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* are engaged to the edges of the first engagement hole **406** and the second engagement hole **407** can be referred to as an engaged state, and a state in which the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* are elastically deformed toward the inner side by the guide ribs **402***a* and **402***b* can be referred to as an inserted state. Then, the direction of deformation between the engaged state and the inserted state of the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* is set as the deformation direction. Further, in the above-described inserted state, each of the pair of hooks **306***a* and **306***b* and the pair of hooks **307***a* and **307***b* are positioned so that the leading edges thereof formed in a tapered shape are overlapped with the first engagement hole **406** and the second engagement hole **407**.

As illustrated in FIG. **4**B, a height B of the pair of guide ribs **402***a*, **402***b* from the attaching surface **408** is formed to be higher than a height H from the attaching surface **408** to a base end portion **310** of the first hook portion **306** and the second hook portion **307**. Further, the height B is formed to be lower by a predetermined amount E than a height D from the attaching surface **408** to an apex portion of the light emitting component **302** and the photosensing portion **303**. Further, the guide ribs **402***c* and **402***d* and the regulation rib **403** are formed to have the same height as height B. Thereby, as illustrated in FIG. **4**C, if an operator attaches the photo-interruptor **301** by pinching the photosensing portion **303** with his/her fingers FNG, the fingers FNG will not bump against the guide ribs **402***a*, **402***b*, **402***c* and **402***d* and the regulation rib **403**. In the present embodiment, the predetermined amount E is set to 5 mm, but the length of the predetermined amount E is not limited to this length. For example, if the predetermined amount E is greater than 5 mm, the light emitting component **302** can be easily pinched by fingers FNG but it becomes difficult to insert the hooks **306***a* and **306***b* between the pair of guide ribs **402***a* and **402***b*. Therefore, a value determined by taking into consideration the attachability of the photo-interruptor **301** to the attaching surface **408** by the operator should be used as the predetermined amount E.

In a state where the photo-interruptor **301** is attached to the attaching portion **401**, as illustrated in FIG. **4**A, if external force is applied to the photo-interruptor **301** attached to the attaching portion **401**, the photo-interruptor **301** attempts to rotate in a direction parallel to the short length direction. In the present embodiment, as described above, a minute gap, which is approximately 0.2 mm, is respectively formed between the side surfaces **301***a* and **301***b* of the photo-interruptor **301** and the pair of guide ribs **402***c* and **402***d*.

After the photo-interruptor **301** has been attached to the attaching portion **401**, for example, it is assumed that external force is applied to the photo-interruptor **301** from the direction of the side surface **301***b*. In this state, the gap between the side surface **301***b* and the guide rib **402***d* is widened by the external force, while on the other hand, the

side surface **301***a* abuts against the side surface **402***c***1** of the guide rib **402***c*, regulating the movement of the photo-interruptor **301** to the short length direction. In other words, the pair of guide ribs **402***c* and **402***d* regulates the position of the photo-interruptor **301** in the short length direction. Thereby, even if external force is applied unintentionally to the photo-interruptor **301**, it becomes possible to prevent the engaged state between the first hook portion **306** and the first engagement hole **406** from being cancelled and causing engagement failure. The short length direction refers to a direction intersecting the insertion direction of the first hook portion **306** and the second hook portion **307** of the photo-interruptor **301**.

Attachment of Photo-Interruptor Unit

Next, a method for attaching the photo-interruptor **301** according to the present embodiment to the attaching portion **401** will be described. FIG. **5**A is a view illustrating a method in which the photo-interruptor **301** is moved toward the attaching portion **401**, and FIG. **5**B is a view illustrating a method of engaging the photo-interruptor **301** to the attaching portion **401**. Further, FIG. **5**C is a cross-sectional view of the attaching portion **401**, and FIG. **5**D is a perspective view illustrating a state in which the photo-interruptor **301** is attached to the attaching portion **401**. In a first step of the attachment process, the operator moves the photo-interruptor **301** in a movement direction (arrow F of FIG. **5**A), which is a direction toward the regulation rib **403** from a pair of guide ribs **402***a* and **402***b* and parallel to the attaching surface **408**. In the first step, the pair of hooks **306***a* and **306***b* of the first hook portion **306** is respectively abutted against the guide ribs **402***a* and **402***b* and is deformed inwardly in a short length direction of the photo-interruptor **301** along with the movement of the photo-interruptor **301**. Then, the photo-interruptor **301** moves further and abuts against the regulation rib **403**, by which the first step is completed.

Next, as a second step of the attachment process, the operator moves the photo-interruptor **301** in a state abutted against the regulation rib **403** by the first step to the insertion direction (arrow G of FIG. **5**B), that is, toward the first engagement hole **406**. As illustrated in FIG. **5**C, the regulation rib **403** is formed as a continuous surface to the engagement wall **406***a* of the first engagement hole **406**. Further, the first hook portion **306** (refer to FIG. **4**A) is provided most downstream in the movement direction of the photo-interruptor **301**. By moving the photo-interruptor **301** in a state abutted against the regulation rib **403** in the insertion direction, the first hook portion **306** is inserted to the first engagement hole **406**, and the pair of hooks **306***a* and **306***b* are engaged with the edge of the first engagement hole **406**.

According to the present embodiment, the first hook portion **306** is provided most downstream in the movement direction of the photo-interruptor **301**, but the positional relationship between the regulation rib **403** and the engagement wall is not limited to that described above, depending on the position of the first hook portion of the photo-interruptor. For example, the positional relationship between the regulation rib **403** and the engagement wall should satisfy a position where the first hook portion is insertable to the first engagement hole in a state where the photo-interruptor **301** is abutted against the regulation rib **403**. According further to the present embodiment, the attaching portion **401** is formed so that the second hook portion **307** is inserted to the second engagement hole **407** in a state where the pair of hooks **306***a* and **306***b* is inserted to the first engagement hole **406**. Accordingly, the operator performs, as the attachment process, a first step of moving the photo-interruptor **301** to the movement direction until it abuts against the regulation rib **403**, and a second step in which the photo-interruptor **301** in a state abutted to the regulation rib **403** is moved to the insertion direction. By performing the first step and the second step, as illustrated in FIG. **5**D, the photo-interruptor **301** is attached to the attaching portion **401**, and attachment of the photo-interruptor **301** is completed.

Prevention of Attachment to Rear Surface

FIG. **6**A is a cross-sectional view illustrating a state where the photo-interruptor **301** is attached from the rear side **409** of the attaching portion **401**. FIG. **6**B is a cross-sectional view illustrating a state where the photo-interruptor **301** is attached in a state reversed from the state shown in FIG. **6**A.

The length of the rear side ribs **405***a* and **405***b* (refer to FIG. **3**C) is set longer than a length L (refer to FIG. **4**A) of the photo-interruptor **301** in the short length direction. The rear side rib **405***c* is a rib directed in the direction orthogonal to the rear side ribs **405***a* and **405***b* and arranged between the rear side ribs **405***a* and **405***b* (refer to FIG. **3**C). As illustrated in FIG. **4**B, the height A of the rear side ribs **405***a*, **405***b* and **405***c* is even greater than the greater one of the height H from the attaching surface **408** to the connector portion **304** or a length J from the rear side **409** to the leading edges of the first hook portion **306** and the second hook portion **307**.

Therefore, as illustrated in FIG. **6**A, if an operator attempts to attach the photo-interruptor **301** from the rear side **409**, the connector portion **304** abuts (interferes) against the rear side rib **405***b*, and thereby, attachment of the photo-interruptor **301** to the rear side **409** is prevented. That is, the rear side ribs **405***a* and **405***b* interfere with the photo-interruptor **301** before the photo-interruptor **301** is attached to the attaching portion **401** from the rear side **409**. Further, as illustrated in FIG. **6**B, if the operator attempts to attach the photo-interruptor **301** in a state rotated for 180 degrees from the rear side **409**, the connector portion **304** abuts against the rear side rib **405***a*, and thereby, attachment of the photo-interruptor **301** to the rear side **409** is prevented. Even if the photo-interruptor **301** is forced into the attaching portion **401** in a state where the connector portion **304** is abutted against the rear side ribs **405***a* and **405***b*, the photo-interruptor **301** will not be attached since the length of the rear side ribs **405***a* and **405***b* is long as described above.

Fall Prevention and Removal

FIG. **7**A is a cross-sectional view illustrating a state where the operator has contacted the first hook portion **306** from the rear side **409** after the photo-interruptor **301** has been attached to the attaching portion **401**, and FIG. **7**B is an explanatory view of a removal process of the photo-interruptor **301** by the operator. The operator may erroneously contact the first hook portion **306** and the second hook portion **307** from the rear side **409** after the photo-interruptor **301** has been attached to the attaching portion **401**. For example, as illustrated in FIG. **7**A, in a state where the fingers FNG attempt to push the first hook portion **306** or the second hook portion **307** from the rear side **409**, the rear side ribs **405***a* and **405***c* or the rear side ribs **405***b* and **405***c* abut against the fingers FNG Thereby, pressing force from the fingers FNG applied to the first hook portion **306** or the second hook portion **307** is relieved by the rear side ribs **405***a*, **405***b* and **405***c*, and thereby, the falling of the photo-interruptor **301** from the rear side **409** is prevented.

Meanwhile, when it is necessary to remove the photo-interruptor **301**, such as during periodic maintenance of the apparatus body, as illustrated in FIG. **7**B, the operator can pinch the first hook portion **306** or the second hook portion

307 using his/her fingers FNG Thereby, the first hook portion 306 or the second hook portion 307 will deform inwardly toward the short length direction of the photo-interruptor 301, and the photo-interruptor 301 can be removed from the first engagement hole 406 and the second engagement hole 407.

As described above, according to the present embodiment, by providing the guide rib 402 to the attaching surface 408 of the photo-interruptor 301, the first hook portion 306 can be moved easily to a certain direction while maintaining contact with the guide rib 402. Further, the regulation rib 403 is provided to regulate movement of the photo-interruptor 301 at a position where the first hook portion 306 can be attached to the attaching portion 401, the photo-interruptor 301 can be attached easily. Further, the guide rib 402 has a longer width than the length of the first hook portion 306 in the short length direction, and it is designed to be narrowed toward the regulation rib 403. Thereby, it becomes possible to prevent the occurrence of a state where the first hook portion 306 is damaged by abutting the first hook portion 306 against the guide rib, and the assembling process of the photo-interruptor 301 is facilitated.

The "movement direction" according to the present embodiment refers to a movement direction by design in a state where an operator, or a robot, moves the photo-interruptor 301 in the first step. Even if the actual direction in which the operator moves the photo-interruptor 301 is deviated from the movement direction, the assembling operation can be performed without any problem if the deviated direction is within a permissible range.

The movement direction according to the present embodiment is a direction parallel to the attaching surface 408, and it is described as a direction corresponding to the longitudinal direction of the photo-interruptor 301 in the state after assembly. However, the deformation direction of the hook portion provided on the photo-interruptor and a direction obliquely intersecting the insertion direction of the hook portion to the hole provided on the attaching surface can be set as the movement direction. Even according to this case, an effect similar to the present embodiment can be achieved by providing a guide portion that guides the hook portion to be deformed in the deformation direction and a regulating portion that regulates the position of the photo-interruptor in the movement direction.

Second Embodiment

With respect to the first embodiment, the present embodiment further provides a second guide rib 410 that guides the hook portion 307 on both ends of the second engagement hole 407. Further, the second guide rib 410 is formed integrally with each of the guide ribs 402*a* and 402*b*. In the description of the present embodiment, only the portions that differ from the first embodiment will be described.

Detailed Configuration of Phot-Interruptor Unit

FIG. 8A is a perspective view illustrating the photo-interruptor unit 300 that is configured by attaching the photo-interruptor 301 to the attaching portion 401 according to the present embodiment. FIG. 8B is a top view of the attaching portion 401 in which the photo-interruptor 301 is not shown, and FIG. 8C is a side view of a state in which the photo-interruptor 301 is attached to the attaching portion 401. The attaching portion 401 according to the present embodiment includes the second guide rib 401 and a pillow rib (supporting rib) 411 in addition to the first guide rib 402 and the regulation rib 403. The second guide rib 410, i.e., second guide portion, includes guide ribs 410*a* and 410*b* that guide the hook portion 307, guide ribs 410*c* and 410*d* that are provided in parallel and opposed to each other, and guide ribs 410*e* and 410*f* that are positioned at a distance that is wider in opposing distance than the guide ribs 410*c* and 410*d*. The distance in the short length direction between guide ribs 410*a* and 410*b*, i.e., third rib portion and fourth rib portion, is set to be narrower as it approaches the regulation rib 403 in the longitudinal direction. In an area where the distance in the short length direction has been narrowed to a predetermined distance, the guide ribs 410*a* and 410*b* are respectively connected to the guide ribs 410*c* and 410*d*. The guide ribs 410*c* and 410*d* are arranged in parallel in the longitudinal direction and arranged with a gap formed in the short length direction. Side surfaces 410*c*1 and 410*d*1 of the guide ribs 410*c* and 410*d* are opposed to the side surfaces 301*a* and 301*b* with a slight gap formed therebetween in a state where the photo-interruptor 301 is attached to the attaching portion 401.

Further, as illustrated in FIG. 8B, an opposing distance K between the guide ribs 410*e* and 410*f* is set wider than the distance between the hook portions 306 and 307 of the photo-interruptor 301, that is, wider than length L of the photo-interruptor 301 in the short length direction (refer to FIG. 4A). Therefore, by moving the photo-interruptor 301 in the movement direction after inserting the pair of hooks 306*a* and 306*b* between the guide ribs 410*e* and 410*f*, the pair of hooks 306*a* and 306*b* will respectively abut against the guide ribs 402*a* and 402*b*. If the photo-interruptor 301 is moved even further toward the movement direction, the pair of hooks 306*a* and 306*b* are bent inwardly in the short length direction of the photo-interruptor 301 to a shape capable of being engaged with the edge of the first engagement hole 406. The first hook portion 306 will be inserted in the bent state to the first engagement hole 406, by which the pair of hooks 306*a* and 306*b* are engaged with the edge of the first engagement hole 406. Further, when attaching the second hook portion 307, by inserting the second hook portion 307 between the guide ribs 410*a* and 410*b*, side surfaces 410*a*1 and 410*b*1 of the guide ribs 410*a* and 410*b* will respectively abut against the pair of hooks 307*a* and 307*b* of the hook portion 307. Thereafter, by moving the photo-interruptor 301 toward the regulation rib 403, the second hook portion 307 will be deformed in the deformation direction by guide ribs 412*a* and 412*b* to a shape capable of being engaged with the edge of the second engagement hole 407. The second hook portion 307 will be inserted in the bent state to the second engagement hole 407, by which the pair of hooks 307*a* and 307*b* are engaged with the edge of the second engagement hole 407.

A pillow rib 411 is arranged at a position below the connector portion 304 in a state where the photo-interruptor 301 is attached to the attaching portion 401. The pillow rib 411 prevents the connector portion 304 from being deformed and causing the photo-interruptor 301 to fall when eternal force is applied to the connector portion 304 from above. As illustrated in FIG. 8C, a height M from the attaching surface 408 to a portion of the guide ribs 410*c* and 410*d* and the guide ribs 410*e* and 410*f* is lower than a height N from the attaching surface 408 to a recessed portion 300A of the light emitting component 302 and the photosensing portion 303. Thereby, it becomes possible to prevent the flag portion 914 (refer to FIG. 2B) from being interfered when passing between the light emitting component 302 and the photo-sensing portion 303.

Attachment of Photo-Interruptor Unit

Next, a method for attaching the photo-interruptor 301 according to the present embodiment to the attaching portion

401 will be described. FIG. 9A is a view illustrating a method of moving the photo-interruptor 301 toward the attaching portion 401, and FIG. 9B is a view illustrating a method of engaging the photo-interruptor 301 to the attaching portion 401. FIG. 9C is a perspective view illustrating a state where the photo-interruptor 301 is attached to the attaching portion 401. In the first step of the attachment process, the operator moves the photo-interruptor 301 in the movement direction, i.e., arrow F of FIG. 9A, set to a direction moving from a pair of guide ribs 402*a* and 402*b* toward the regulation rib 403 and parallel to the attaching surface 408. At this time, by moving the photo-interruptor 301 in the movement direction after inserting the first hook portion 306 between the guide ribs 410*e* and 410*f*, the pair of hooks 306*a* and 306*b* can be easily abutted against the guide ribs 402*a* and 402*b*.

In the first step, the pair of hooks 306*a* and 306*b* of the first hook portion 306 respectively abut against the guide ribs 402*a* and 402*b*, and along with the movement of the photo-interruptor 301, deforms inwardly in the short length direction of the photo-interruptor 301. Further, along with the movement of the photo-interruptor 301, the second hook portion 307 will abut against the guide ribs 410*a* and 410*b*. Then, by moving the photo-interruptor 301 further toward the regulation rib 403, the second hook portion 307 will be deformed in the deformation direction by the guide ribs 412*a* and 412*b*. Then, the photo-interruptor 301 moves further and abuts against the regulation rib 403, by which the first step is completed.

Next, as a second step of the attachment process, the operator moves the photo-interruptor 301 in a state abutted against the regulation rib 403 in the first step toward the insertion direction, that is, toward the first engagement hole 406. The regulation rib 403 is formed as a continuous surface to the engagement wall 406*a* of the first engagement hole 406 (refer to FIG. 5C). Further, the first hook portion 306 is provided most downstream in the movement direction of the photo-interruptor 301. By moving the photo-interruptor 301 in a state abutted against the regulation rib 403 in the insertion direction, the first hook portion 306 is inserted to the first engagement hole 406, and the pair of hooks 306*a* and 306*b* are engaged with the edge of the first engagement hole 406. Further, along with the movement of the photo-interruptor 301 in the insertion direction, the second hook portion 307 in the deformed state will be inserted to the second engagement hole 407, and the pair of hooks 307*a* and 307*b* will be engaged with the edge of the second engagement hole 407.

According to the present embodiment, similar to the first embodiment, the first hook portion 306 is provided most downstream in the movement direction of the photo-interruptor 301. However, the positional relationship between the regulation rib 403 and the engagement wall is not limited to that described above, depending on the position of the first hook portion of the photo-interruptor. For example, the positional relationship between the regulation rib 403 and the engagement wall should satisfy a position where the first hook portion is insertable to the first engagement hole in a state where the photo-interruptor 301 is abutted against the regulation rib 403. Similarly, according to the present embodiment, the attaching portion 401 is formed so that the second hook portion 307 is inserted to the second engagement hole 407 in a state where the pair of hooks 306*a* and 306*b* is inserted to the first engagement hole 406. Accordingly, the operator performs, as the attachment process, a first step of moving the photo-interruptor 301 to the movement direction until it abuts against the regulation rib 403, and a second step in which the photo-interruptor 301 in a state abutted to the regulation rib 403 is moved to the insertion direction. By performing the first step and the second step, as illustrated in FIG. 9C, the photo-interruptor 301 is attached to the attaching portion 401, and attachment of the photo-interruptor 301 is completed.

As described, according to the present embodiment, the guide rib 402 and the second guide rib 410 are provided integrally to the attaching surface 408 of the photo-interruptor 301. Thereby, the first hook portion 306 and the second hook portion 307 can be moved easily to a certain direction in a state being respectively abutted against the guide ribs 402 and 410. Further, the regulation rib 403 is provided to restrict movement of the photo-interruptor 301 at a position where the first hook portion 306 and second hook portion are attachable to the attaching portion 401, and so the attachment of the photo-interruptor 301 is facilitated. Further, the guide rib 410 has a width longer than the length of the first hook portion 306 in the short length direction, and the width of the guide rib 410 is narrowed toward the regulation rib 403 to allow deformation of the first hook portion 306. Further, the guide rib 410 has a width longer than the length of the second hook portion 307 in the short length direction, and the width of the guide rib 410 is narrowed toward the regulation rib 403. According to such configuration, it becomes possible to suppress the occurrence of a state where the first hook portion 306 and the second hook portion 307 are damaged during abutment against the guide rib, and the assembling process of the photo-interruptor 301 is facilitated.

According to the first and second embodiments described above, a gap is formed between the side surfaces 301*a* and 301*b* and the pair of guide ribs 402*c* and 402*d* or the second guide ribs 410*c* and 410*d*, but the gap is not necessary.

Further, the application of the photo-interruptor unit 300 is not limited to sheet detection, and the photo-interruptor unit 300 can be applied to detecting movement of other components such as the opening and closing of a door member. Further, the photo-interruptor unit 300 is not limited to being provided in the apparatus body 900A, and it can be provided in the document conveyance apparatus 950A or other devices such as a finisher connected to the apparatus body and providing various processes to the printed sheets.

The above-described embodiments have been illustrated based on the printer 900 adopting an electrophotographic system, but the present embodiments are also applicable to other types of image forming apparatuses, such as an ink-jet image forming apparatus in which images are formed on sheets by discharging ink.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2019-090180, filed May 10, 2019, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A photo-interruptor unit comprising:

a photo-interruptor comprising a light emitting component configured to emit light, a photosensing portion configured to receive light emitted from the light emitting component, and a hook portion configured to deform elastically in a deformation direction; and

a supporting portion configured to detachably support the photo-interruptor,

wherein the supporting portion comprises an attaching surface to which the photo-interruptor is attached, a hole which is formed on the attaching surface and through which the hook portion is inserted in an insertion direction, a guide portion configured to protrude from the attaching surface and configured to guide the hook portion so that the hook portion deforms elastically in the deformation direction in a state where the photo-interruptor is moved in a movement direction intersecting the insertion direction and the deformation direction, and a regulating portion configured to protrude from the attaching surface and to form continuously with the guide portion, and configured to regulate a position in the movement direction of the photo-interruptor whose hook portion has been guided by the guide portion to a position where the hook portion is overlapped with the hole,

wherein the guide portion comprises a first rib portion and a second rib portion that are configured to oppose one another in the deformation direction, and a distance between the first rib portion and the second rib portion in the deformation direction become shorter as it goes toward a downstream direction of the movement direction,

wherein the hook portion is deformed elastically in the deformation direction by contacting with the first rib portion and the second rib portion, and the hook portion is further deformed elastically in the deformation direction by moving the photo-interruptor toward the downstream direction of the movement direction.

2. The photo-interruptor unit according to claim **1**,

wherein the hook portion comprises a pair of hooks that are arranged in parallel in the deformation direction, and

a distance in the deformation direction between an upstream end of the first rib portion in the movement direction and an upstream end of the second rib portion in the movement direction is greater than a distance between the pair of hooks that are not in an elastically deformed state at a most distant position in the deformation direction.

3. The photo-interruptor unit according to claim **2**,

wherein the guide portion comprises a position regulating portion configured to oppose the photo-interruptor in a state where the hook portion is inserted to the hole, and configured to regulate a position of the photo-interruptor in the deformation direction, and

the position regulating portion is positioned downstream of the first and second rib portions and upstream of the regulating portion in the movement direction.

4. The photo-interruptor unit according to claim **3**,

wherein the position regulating portion comprises a pair of position regulating surfaces extending in a direction parallel to the insertion direction and the movement direction, and which are arranged with a predetermined distance therebetween in the deformation direction.

5. The photo-interruptor unit according to claim **1**,

wherein the photo-interruptor comprises a connector portion arranged in line with the light emitting component and the photosensing portion in the movement direction, and having wiring connected thereto, and

a distance of the regulating portion from the attaching surface in a state where the photo-interruptor is attached to the supporting portion is greater than a distance from the attaching surface to the connector portion.

6. The photo-interruptor unit according to claim **5**,

wherein the hook portion, the hole and the guide portion are respectively a first hook portion, a first hole and a first guide portion,

the photo-interruptor comprises a second hook portion arranged closer to the connector portion than the first hook portion in the movement direction and configured to deform elastically in the deformation direction,

the supporting portion comprises a second hole to which the second hook portion is inserted, and a second guide portion formed to protrude from the attaching surface and configured to guide the second hook portion to deform the second hook portion in the deformation direction,

the second guide portion comprises a third rib portion and a fourth rib portion that are arranged to oppose one another in the deformation direction, and

a distance between the third rib portion and the fourth rib portion in the deformation direction become shorter toward a downstream direction of the movement direction.

7. The photo-interruptor unit according to claim **6**, wherein the regulating portion, the first guide portion and the second guide portion constitute a rib that is formed continuously.

8. The photo-interruptor unit according to claim **7**,

wherein the photo-interruptor comprises a recessed portion between the light emitting component and the photosensing portion, and

in a state where the photo-interruptor is attached to the supporting portion, a distance from the attaching surface of the rib at an area opposed to the recessed portion in the deformation direction is shorter than a distance of the recessed portion from the attaching surface.

9. The photo-interruptor unit according to claim **8**,

wherein in a state where the photo-interruptor is attached to the supporting portion, the distance, from the attaching surface, of the rib at an area opposed to the light emitting component and the photosensing portion in the deformation direction is greater than the distance of the recessed portion from the attaching surface and shorter than the distance of the light emitting component and the photosensing portion from the attaching surface.

10. The photo-interruptor unit according to claim **1**,

wherein the supporting portion comprises an opposite surface-side rib that is protruded from an opposite surface that is opposite from the attaching surface of the supporting portion, and

in a state where the photo-interruptor is attached to the supporting portion with respect to the opposite surface, the opposite surface-side rib interferes with the photo-interruptor and regulates attachment of the photo-interruptor.

11. A sheet conveyance apparatus comprising:

a conveyance portion configured to convey a sheet;

a moving unit configured to be pressed and moved by the sheet conveyed by the conveyance portion, and configured to block light emitted from the light emitting component to the photosensing portion; and

the photo-interruptor unit according to claim **1**, configured to output a detection signal when detecting the sheet according to a photosensing state of the light emitted from the light emitting component by the photosensing portion.

12. An image forming apparatus comprising:

an image forming unit configured to form an image on a sheet; and

the sheet conveyance apparatus according to claim **11**.

* * * * *